

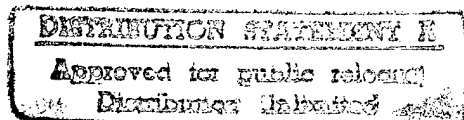
DEVELOPING A CAMPAIGN PLAN TO
TARGET CENTERS OF GRAVITY WITHIN
ECONOMIC SYSTEMS

A Research Paper

Presented to

The Directorate of Research

Air Command and Staff College



In Partial Fulfillment of the Graduation Requirements of ACSC

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ABSTRACT

In 1994, Arnold et al. conducted a research study which attempted to mathematically model a nation's economy. Titled *Targeting Financial Systems as CoGs: Low Intensity to No Intensity*, the results of this study purported to identify specific financial elements that could provide likely targets for the conduct of economic warfare.

This project furthers the original statistical effort and adds to this a campaign planning approach (including both systems and operational level analyses) for more clearly identifying these likely targets. Although various critical elements were identified for each country, one of these—trade—cut across the broad spectrum of GDP values. As a result, for the purposes of this research, trade was overall defined as that element which contributed most to each national economy. Subsequently, communications and data networks were identified as those subsets of the trade system which could provide the most lucrative intervention sites.

Because of the trade/communications and data network relationship and the modern tendency to limit the collateral influence of an attacker's actions, this project also addresses new methods of warfare which, surprisingly, are readily available today in a variety of forms.

Finally, this project addresses the possible ramifications of the transition of warfare from its traditional form. But while the preceding sections can provide a planner a usable framework, this last can only provide fuel for continuing the ongoing national debate.

DEVELOPING A CAMPAIGN PLAN TO TARGET CENTERS OF GRAVITY WITHIN ECONOMIC SYSTEMS

Chapter 1: Introduction

Economic warfare has been a vital part of the way the United States has dealt with other nations since the country was founded. In most cases it has been the first action of choice. Examples range from the Revolutionary War, the embargo against Britain in 1808, the Civil War, the Gulf War and most recently the embargo against Haiti. Since this type of warfare has been such an integral part of this country's past and as modern societies strive for bloodless war, it is safe to assume that the economic option will continue to be an important player in our arsenal of options to try to bend the will of another nation to our own. But has economic warfare been used as effectively as it could have been to reach the desired objectives? Can this nation use it more effectively in the future? The Haiti situation is a good example to answer these questions. Many will argue that economic warfare was not successful since it took, for all intents and purposes, an invasion to make the military junta bend to our will. So, how does a nation plan and implement an effective economic warfare campaign?

This paper builds upon concepts mentioned in the article entitled "Targeting Financial Systems as COGs: 'Low Intensity' to 'No Intensity' Conflict," but goes far beyond that article's scope. This is believed to be the first time a product has been written specifically about building a campaign plan to conduct economic warfare. The purpose is

to develop a framework to identify where a nation's capabilities need to be applied to achieve the maximum effect desired from economic warfare. It concentrates on financial systems as centers of gravity to cause another nation to change. All cultures are not dependent upon the same financial centers. This paper has created a new model that will aid in empirically identifying which financial centers in specific countries would be the best to influence. Then once the most lucrative financial center is identified a "systems" analysis will be conducted to identify critical nodes to be influenced by both lethal and nonlethal attack.

The paper draws on the air campaign planning model taught at the Air Command and Staff College (Figure 1). It starts with the importance of identifying the end state and

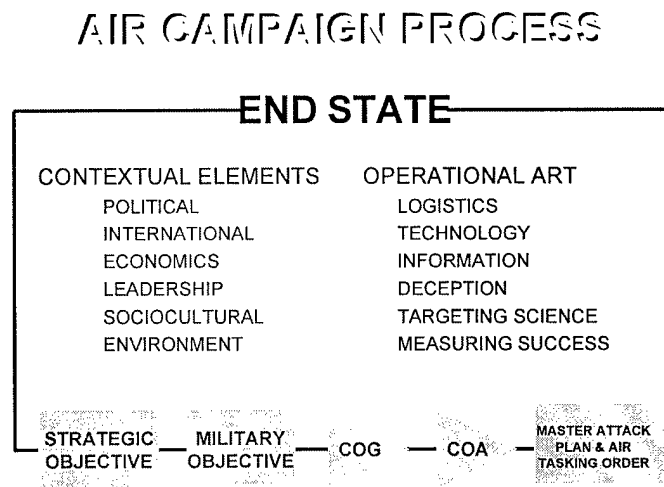


Figure 1. Air Campaign Planning Model

objectives. Once these are established military planners perform a strategic analysis of the trade system as a whole in order to identify centers of gravity. It is in this section that the

model for identifying the best financial centers to influence a specific nation is discussed. Since the scope of the paper only allows for one financial center to be looked at systematically trade was selected and a computer analytical tool was used to identify its critical nodes. The surprising results of the analysis showed that communications and data networks are the two most important critical nodes of the trade system. These nodes were then broken down into specific target sets and ways were identified to attack them by the use of cyberwar. Finally the paper ends with a discussion about future implications this new type of warfare brings to light.

Chapter 2: Determining End State and Setting Objectives

This section discusses in general terms the idea of end state and objective since we are building a specific campaign for a specific country. As in any military operation, planners must begin with a desired end state, a vision of what the adversary's nation should look like after the campaign is completed. In this case it must be determined to what level the nation's economy should be affected. The end state summarizes the planners' intentions and is necessary to unify the effort of those involved in executing the attack. The end state can then be broken down into several objectives or the goals the planners hope to achieve through their actions. Concise, attainable, measurable and time limited, these objectives provide the direction for the remainder of the campaign. The objective setting process begins at the highest level of national leadership and is refined by various leadership levels until it reaches the planners. For example, the national leadership may set an objective of decreasing the export capability of a target state. This strategic objective is refined into reducing the quantity of a particular export commodity, which in turn is broken down into the tactical objective of eliminating the electronic fund transfer system used to pay for the commodity. Once planners understand the end state and have developed the military objectives the next step is to determine how best to obtain them.

Chapter 3: Identification of Vital Financial Centers

With objectives in mind, planners now face the task of analyzing the individual components of the target state's economy. To aid in this analysis a model has been developed to identify key financial centers that are vital to a specific nation's economy. By identifying the centers that have the greatest effect on a nation's economy the planners can focus their strategic analysis efforts.

This model is a new version of the Arnold et al model published in the article "Targeting Financial Systems as COGs: 'Low Intensity' to 'No Intensity' Conflict" in the journal *Defense Analysis*. The new model further validates the original and makes it more useful by using time series data and multiple regression techniques to establish the relationship of the variables (financial centers) within **specific** economic systems over time.

Relationship to Previous Model

The article listed above states that "Disrupting an adversary's economy will directly affect the ability of the system to support its military forces, provide the nation's organic essentials (energy, food, minerals and other commodities) and infrastructure (highways, ports, railroads)."¹ To demonstrate this premise, the Arnold research effort used statistical analysis to determine the relationship of five financial factors (banks, stock markets, foreign debt, volume of exports, and volume of imports) within national economies. Gross Domestic Product (GDP) was used to measure the size of national economies.² The cross sectional analysis covered some 99 countries over a single period,

1984, and concluded that a quantitative relationship between GDP and the five factors exists. Affecting one or more of the factors would affect GDP and thus by extension, influence the leadership to bend to another nation's will. While the model departs from the commonly accepted definition of GDP, it can provide useful insight into the basic nature of a country's economic system.

Arnold et al used simple regression techniques within a multiple variable model to determine a direct relationship between a specific variable and GDP formation. This paper's multiple regression techniques will incorporate all the variables and provide valuable information regarding the cross relationships between variables and the dynamic effect of all the variables on GDP. Further, time series analysis will provide valuable evidence of the sensitivity of the model over time. From this analysis it will be shown that the model, in its general form, is a useful tool for a planner to identify the most critical financial factors to influence GDP within economic systems.

Methodology

Method of Analysis and Data. The empirical data analysis will take the form of multiple linear regression analysis of GDP factors for a number of countries. Normally acceptable statistical tests will be used and the models adjusted accordingly where appropriate. By first developing the models sufficiently, their utility to planners will be demonstrated. (Regardless of their strength however, the planner should still fully develop a model for a given country to determine the causal effects.) Other forms of regression models such as log-linear and curvilinear are not considered in order to limit the scope of the study. The research strategy for this section begins with an examination of a current

model based on the Arnold study. It will be further developed for specific countries using time series analysis. For each country selected a regression will be performed, followed by complete statistical inference tests to validate the model overall.

The data for the model was readily available for most of the countries selected. However some countries were substituted for others for when incomplete data was available. Because consistency was vital to the overall analysis of the information, a single source—the International Monetary Fund—was selected for reporting and measurement.

Selection of Variables. The basis for the empirical analysis lies in the somewhat simplified linear regression model proposed by Arnold et al³:

$$\text{GDP} = \alpha + \beta_b B + \beta_s S + \beta_d D + \beta_e E^2 + \beta_i I^2 \quad (1)$$

where

GDP = Gross Domestic Product

B = Total assets of banks

S = Total capitalization of stock markets

D = Foreign debt, total amount held outside of the country

E = Total volume of exports

I = Total volume of imports

The regression analysis further reduced the model such that each variable was compared separately against GDP. An exponential relationship between both exports and imports was established. The shortfalls in this analysis will be addressed by using multiple regression techniques while also continuing the initial research into the area of time series.

In this paper the premise is accepted that GDP is the most comprehensive measure of a nation's total output of goods and services and is a widely accepted indicator of national power. Also, the model was reduced to eliminate stock markets as a variable under consideration—several of the countries previously examined have no such

institution, and others do not report their market capitalization in a consistent format. A second market specific consideration is that owing to the global nature of stock markets, if an action is taken against one of the major stock markets, all others would probably react simultaneously. The effect felt by attacking one market would probably result in panic, or close to that situation as the world system seeks to regain stability in the market place. Fundamental to our analysis, however, is the consideration to eliminate unpredictable collateral damage.

The remaining variables are considered as having a potentially strong relationship to GDP for analysis purposes. The liquidity of central banks is an important contributor in the sense that the stability of currency is vital to sustained growth in GDP. Trade, or the sale or purchase of goods and services, is also a critical factor in the determination of GDP. Because of the twofold nature of trade, it has been broken into export and import categories. Lastly, the level of foreign debt a country maintains can have a positive or detrimental effect on a nation's economy. Including foreign debt in the model will account for the financing effect related to GDP.

The original model appeared to indicate a multiple regression approach. In fact, GDP was compared against each independent variable separately. Also, there was no basis to support the results indicating that exports and imports were exponentially related to GDP within a multiple regression approach. As such, this analysis will use stated values and adjust accordingly if the results indicate mis-specification.

Finally, this analysis differs from the Arnold study in that it will concentrate on the macro aspects of the variables. As a result, the new model in the general form will be defined as:

$$\text{GDP} = \alpha + \beta_b B + \beta_d D + \beta_e E + \beta_i I \quad (2)$$

where

GDP = Gross Domestic Product as defined in International Financial Statistics (IFS) line 99b as the sum of final expenditures of Exports of Goods and Services, Imports of Goods and Services, Private Consumption, Government Consumption, Gross Fixed Capital Formation, and Increase or Decrease in Stocks.⁴

B = A measure of national bank liquidity. (For these purposes, currency markets have been chosen as the means to influence the national banking system. This variable comprises the currency reserves of national banks to include foreign currency holdings and gold reserves drawn from IFS as the sum of lines 11.d and 1and). Private banks are excluded from this discussion because of the nature of their holdings. Concerning this variable however, two points should be addressed: a) It is virtually impossible to obtain time series data indicating the scope of foreign money held in banks; and b) bank stocks can be held internationally. The influence of large foreign holders of bank stocks may preclude a country from taking action against private banks of another country.)

D = Government foreign debt at year end (drawn from IFS national account data line 89a). The reported amount of foreign debt in the national accounts is used for this variable. Again, the foreign debt of private companies is virtually impossible to obtain with any degree of accuracy over a period of time.

E = Exports of goods and services (drawn from IFS national account data line 90c). Note: For several countries this value was stated only as the export of goods. This variable is represented by the value of goods and services exported from a country. All other factors held constant, increases in exports should increase the GDP of a country.

I = Imports of goods and services (stated as a negative value in IFS national account data line 98c). This negative sign of the variable was retained in this analysis. Similar to exports, this variable measures the value of goods and services imported by a country. Imports should have an relationship opposite to exports to GDP formation.

Country Selection. The countries considered in the cross sectional analysis comprised a wide range of GDPs. In their paper, Arnold et al utilized GDP values to segregate economies into high, mid, and low GDP ranges.⁵ This analysis selected five countries at random from each of the three GDP categories for a total of fifteen countries.

The same break points for determination of high, mid, and low GDPs—based on 1984 US dollar based GDP values—were used:

High: GDP > \$200,000 million

Mid: GDP > \$55,000 million

Low: GDP < \$55,000 million

The fifteen countries under consideration were:

Table 1. GDP Levels for Selected Countries

GDP Level		
High	Mid	Low
United States (control sample)	Mexico	Colombia
Japan	Taiwan (Libya substitute)	Nigeria
Brazil	Argentina	Singapore
China (Korea substitute)	South Africa	North Korea
India	Iran	Zimbabwe

Immediately, however, it was discovered that data availability for several of the countries was an issue for concern and had to be reconsidered when using the model. Specifically, data was unavailable for Taiwan, North Korea, and China. No suitable alternate could be chosen for North Korea; alternates could be chosen, however, for China (South Korea) and Taiwan (Libya). Thus, the final analysis considered fourteen countries.

Several other countries had less than complete data for all four analysis factors (B,F,E,I) over the 30-year study period. However, sufficient data was available to complete the analysis for the majority of the factors. Adjustments to the sample size were

made where appropriate for each country. For example, the data for Singapore's exports was equated to imports, and the Singapore model adjusted accordingly.

Data Sources. In dealing with time series data the problem of inconsistent reported data values must be considered because this analysis attempts to validate a model across different countries. To minimize this problem, a single source for data—the IFS provided by the International Monetary Fund (IMF)⁶—was used to standardize reporting aspects. The IMF sets out a standard of reporting and measurement of values for various categories, and IMF member countries report periodically based on specific, well understood definitions.

All values are expressed in terms of IMF Special Drawing Rights (SDR) to reduce currency bias.⁷ Using the SDR eliminated comparison of economic data based on conversion to a specific currency such as the US dollar. Additionally, many of the countries considered did not have a currency that is widely traded. Their transactions utilize many foreign currencies and thus the “own nation” values expressed in the economic data are subject to currency bias. Conversion of the nation's currency data to SDR values lessened the impact and provided a fairer means of comparison.

Regression Techniques. Standard multiple regression analysis techniques were used throughout. The Arnold cross sectional analysis utilized simple regression for each variable separately against GDP to determine whether it should be considered as a viable target. The multiple regression model used in this paper provided a more sophisticated analysis of the variables and accounted for cross variable effects on the dependent variable, GDP. More simply stated, the multiple regression technique accounts for the total effect of all the considered independent variables on the formation of the independent

variable, GDP. Thus, where the original cross sectional analysis identified variables as likely targets for attack, this analysis may differ. The sample size was the 30-year period covering 1964-1993 unless data was not available for the earlier years or the final period. The statistical techniques were adjusted for small sample analysis where applicable.

Linear regression uses data for a number of variables and mathematically determines the "best fit" of data to a linear model. The coefficients for the variables are an indicator of the sensitivity of the dependent variable (GDP) to changes in the independent variables (B,F,E,I). In this model, GDP is predicted by the sum of the values of the financial indicators multiplied by their estimated coefficients. The value α is referred to as the intercept value and is indicative of the level of GDP determined by items other than the independent variables. Additionally, because the regression line is an estimate, there is some degree of error, termed the residual.

The data and regression results are reported in the Statistical Appendix. Standard statistical tests are utilized to validate the model.⁸

Summary of Results

The regression was run for each of the fourteen countries using the general form of the model. See Appendix A for country-specific results. The results provide a general direction for the further examination of each model. Table 2 is based on the final form of the model for each country and indicates which financial center planners should influence in order to have the greatest impact on GDP. For example, if the targeted country was Columbia the results from the model tell the planners that banks, exports, and imports are

the most likely areas to target. The planner should then conduct a detailed systems analysis of these areas to find specific critical nodes and then centers of gravity.

Conclusions

Linear regression techniques provide a useful means for examining the composition of GDP. It is clear that each country's economic structure is different and that the relatively straightforward multiple linear regression model used in this study requires modification depending upon the country examined. It has been shown that the factors of banks, foreign debt, exports, and imports are related to GDP formation, but at different levels for each country. Further, it has been shown that the same factors for each country may not be entirely significant in the formation of GDP.

Table 2. Decision Matrix for Influence on Variables

Country	Variable			
	Foreign Debt	Banks	Exports	Imports
Argentina	*	no	yes	yes
Brazil	*	no	yes	yes
Colombia	no	yes	yes	yes
India	*	no	no	yes
Iran	no	no	no	no
Japan	yes	yes	yes	yes
Korea	no	yes	yes	no
Libya	*	yes	no	no
Mexico	*	no	no	yes
Nigeria	no	no	no	yes
Singapore	*	yes	no (note 1)	N/A
South Africa	yes	yes	yes	no
United States	yes	no	yes	yes
Zimbabwe	yes	yes	yes	yes

- Notes: 1. Singapore Exports are net of Imports.
2. Based on final form of the models and significant at .05 confidence.
3. An asterisk indicates that the variable was not included in the final form of the model.

Across the regression models, the combination of exports and imports, generically referred to as **trade**, appears to be the most consistently significant with high degrees of correlation between the two variables. Further study should first focus on aspects of trade as a means of influencing GDP.

The general form of the model also proved useful in establishing a relationship among the individual variables. In virtually all cases the Goodness of Fit statistic showed that the models explained a high proportion of the variation and that they were all statistically significant as a whole. However, the time series nature of the data coupled with the evidence of positive autocorrelation among residuals means that the predictive nature of the model is questionable.

Where the utility of the models were proved questionable, these areas were identified as requiring further study including the possibility that the relationship among the variables is not linear. This result by itself is valuable to planners attempting to determine possible centers of gravity.

The importance of economic stability cannot be overstated. Supporting a viable military can only be accomplished through a stable and strong economic base. The ability to identify and influence those key financial centers in an economy may well prove to be a powerful weapon in a country's arsenal.

Limitations

The conclusions of this empirical study have certain limitations. First, there was no attempt to develop models that are predictive in nature. Rather, the intent was to show a relationship that must be further developed through more thorough analysis. For example, once the decision is made to study a country in detail, this analysis will allow the planner to determine if further examination of financial systems as potential centers of gravity is warranted.

Second, no account for time lag influence was examined. The proper methodology first established the relationship and then refined the exact nature of the influence of the independent variables on the dependent variable. It is beyond the scope of this limited study to fully refine these models to determine the time effect that would occur on GDP by influencing one of the variables.

Third, changes in economic structure are not accounted for. The annual data covered a period of time in which the world saw significant change. Countries that were

considered economically underdeveloped at the start of the period could in some cases now be considered important in the world economy. Limitations on methods to quantify the structural changes also limited the analysis' ability to appropriately adjust the models to take this into account.

Finally, the capacity of the individual countries to increase GDP is limited by resources. Small countries such as Singapore may possess enormous personal capital, but lack the ability to increase capacity without technological change. This is not accounted for in the data.

Areas for Further Research

Many specific areas for further research are indicated throughout the country by country analysis. This section identifies some of those areas.

Detailed study of a few of the countries may lead to a better understanding of the time sensitive nature of the data. Regressions using lagged data in various combinations for various periods could lead to results that are predictive in nature. The true effect of influencing one or more of the independent variables will be illustrated if the model can be further refined.

Most important is the question of specification. Further research may reveal that a critical variable is missing from one of the analyses. That variable could prove to be the most likely center of gravity within an economic system. Only through rigorous examination of economies on a country-by-country basis will the full effect of adding additional variables be determined.

There is no single model that can adequately explain all the factors of GDP formation for all countries. But by establishing a general relationship, a path is laid for further detailed research which seeks to identify the analytical significance of economic institutions as potential centers of gravity in influencing GDP.

Chapter 4: Systemic Analysis of the Trade System

Using the statistical analysis from Chapter 3, planners have a model to identify the best financial centers in a country through which to achieve the desired objectives and end state. The next step is to conduct a systems analysis of all the significant financial centers of that nation. Since conducting a detailed analysis of all four financial centers used in the model is beyond the scope of this paper it was decided to concentrate on the one which impacted the largest range of countries—this financial center was **trade**.

In order to effectively target an enemy's trade system, military planners must understand how the system is structured and determine its organization and key linkages. In short, they must know where to specifically target a system to achieve the objective. Additionally, an economic system cannot be destroyed with complete impunity. Ramifications, such as collateral damage to the economic system, must be minimized or eliminated. Targets themselves have to be vulnerable to the selected method of attack, and the forces used by the attacker should not be placed at unnecessary risk. All these factors combine to point us toward centers of gravity—defined by von Clausewitz in *On War* as “The hub of all power and movement, on which everything depends. That is the point against which all our energies should be directed.”⁹

Unlike the statistical analysis described in Chapter 3, it would be difficult and time consuming to completely break down the trade system of all fourteen countries analyzed. Statistics, by their nature, lend themselves to objective analysis. Countries and their trade systems unfortunately do not. But in the broad scope, country specific systemic analysis is less important than understanding the similarities between the systems—planners should

attempt to identify denominators common to all, with these denominators becoming pointers to the centers of gravity within these common systems. Once a specific country is identified for detailed study then these common denominators can be used to understand and study that country.

Colonel John Warden, in his article, "The Enemy as a System,"¹⁰ provides a usable framework for accomplishing this kind of analysis. Starting with five basic categories (Leadership, System Essentials, Infrastructure, Population, and Fielded Forces), individual nodes are identified and grouped within these larger headings. Next, linkages are established between nodes in order to determine their interrelationships. Those having the most linkages within the overall system are termed "critical" nodes, and it is this subset that planners examine as sites for possible intervention. Major Paul Moscarelli, in his article "Operational Analysis—An Overview," further defines critical nodes: "Nodes are critical if removal of a given node would cause a system failure or cascading deterioration within the system."¹¹

By using these frameworks, military planners can assess a system—as integrally as desired—and identify those areas or critical nodes which are particularly sensitive to intervention. Subsequently, they can evaluate those areas against such factors as risk, vulnerability, speed, and others and determine those specific centers against which they can achieve their desired objective at the least possible cost. Using this methodology, an analysis was conducted on a generic national trade system. Although several nodes were subjectively identified as being critical, two stood apart from the rest: communications and data networks. These specific nodes were further evaluated using a validation process and clearly identified as the areas against which planners should stage their interventions.

But the purpose of this chapter is not to analyze communications and data networks—this will be accomplished later. Instead, a closer look should be taken at how the model was established and the process by which centers of gravity for a trade system were actually identified.

Trade System Nodes

Leadership. Warden equates the leadership of a system to the human brain—the center of the system which gives direction and meaning to the system's existence.¹² It is important to note that leadership transcends the individual leader. Instead, it encompasses the system that exists at the center of an entity; the system which allows the leader to set policy and control. In the case of a country's trade system, several nodes—both internal and external to the country's boundaries—fall into the category of leadership.

The first and most critical leadership node in the trade system is the individual government: from the ruler, to the legislative body(s), to departments within the government which control monetary policy and establish trade policy. A country's trade system is controlled by government policy—or non-policy. Governments establish tariffs, bestow most favored nation status, and encourage production and consumption of goods.

Trade systems are also influenced by external bodies. The Group of Seven (G-7), the leaders of the seven principal industrial powers of the world, annually attend economic summits to review problems and policy and play a major role in establishing worldwide trade administration. Because of the unique position of these economic leaders to backup

their policies, they, by default, become a vital element in the leadership portion of any country's trade system.

In like fashion, the IMF has become a major factor in impacting trade policy, particularly in the economies of the lesser developed countries. If the IMF agrees to loan money or arrange commercial financing to reinforce weak or failing economies, it often requires stringent monetary policy—in the shape of currency reform, for example—as a measure of conditionality in return. This policy can then in turn directly affect a country's trade policies and the goods and their prices available for trade.

Finally, the member governments who are signatories on the General Agreement on Tariffs and Trade (GATT) can be fit into the leadership arena. With such worldwide representation, no other trade treaty has close to the global policy impact that GATT has. Essentially, GATT is set of agreements which establish trade policy between nations.

System Essentials. System essentials are the key elements that allow the system to function—those elements which, while not a part of the decision making process, directly impact decisions and system survival. In the case of the trade system, system essentials are those elements that make up the basic elements of tradable goods and the system which supports trade.

For example, raw materials fuel industry for the production of tradable goods. Often, they are also the primary trade commodity for lesser developed countries, and a country's foreign policy revolves around maintaining the supply and availability of these materials.

Products, meaning types of value added goods, are also an important piece in the trade system for two reasons. First, excess product is a tradable commodity particularly

for more developed economies. Second, product creates demand in a society for both raw materials and labor. The demand for raw materials and fuel to produce the product is often fulfilled by the trade system.

Information fuels trade and is dynamic in its scope. An individual can find information on the availability of products, matters concerning national trade policies, information on prices, and so on—an almost endless list. As the individual with the most information will theoretically make the best deal, information itself subsequently becomes a valuable commodity or system essential.

An economically strong country must have energy resources available to fuel the trade system. Energy sources run factories which produce products and are relied upon by transportation systems to move products. In and of itself, energy resources and their availability can often determine national policy, as demonstrated by coalition actions in the Gulf War. Clearly, energy has high potential to disrupt national economies.

Trading nations need access to a convertible currency as currency fuels trade. Without easy access to a currency which is both recognized and exchanged on the world market, trade can be severely limited. If this occurs, the only real alternative to convertible currency is gold. Until recently, for example, Russia was severely constrained as a trading nation because the ruble was not traded on the global market. This currency had no demonstrated value against the major currencies of the world, resulting in Russia being forced to use gold or other commodities in exchange for imported goods.

Treaties and agreements establish the formal trading rules between individual nations and groups of nations. These elements form the parameters under which nations

deal fairly with each other and protect and maintain their industry while providing a broad spectrum of choices to their consumers.

Finally, intellectual capital—the creative thought and initiative behind the development of a product or process—is particularly critical to nations. However, while this capital does have some impact on the global trade system, it is minimized because of the long lag times seen in transitioning between concept to prototype to marketable product. (Arguably, these time lags are becoming more and more compressed. Computer aided design and engineering have dramatically cut traditional concept-to-market times. However, for the majority of trade commodities, the employment of intellectual capital is a slow process.)

Infrastructure. Infrastructure is the arterial system which ties system essentials to the rest of the trade system. It is a network which transfers product, raw materials, and information to consumers. While organizationally separated from system essentials, infrastructure is no less important in making the trade system work effectively. Simply put, infrastructure facilitates trade.

As mentioned above, information is a priceless commodity to a trading nation. But information is only as good as its accuracy and availability. Communications and data networks facilitate the transfer of information throughout the economic system—whether this information concerns the transfer of credits from one bank to another or instant availability of pricing information to facilitate a decision on currency exchange. No matter what the activity, information plays a significant role and information is not available without the networks that provide it. In conjunction with data transfer, communications linkages are equally important. According to noted futurists Alvin and Heidi Toffler,

“third world postnations . . . still need energy and food, but what they also need now is knowledge convertible into wealth. They need access to, or control of, world data banks and telecommunications networks.”¹³

A second key infrastructure node is industry, or that subsystem which provides the products for trade. In the generic sense, it includes leadership (executive support for production, price, and product decisions), system essentials (raw materials, capital, and energy needed to produce product), and encompasses the factories and capital structures needed for production and storage of raw materials, energy, and finished products. Labor is also a key industry subset in that it provides the efforts that transform raw material into a value added good. Industry can be related to trade just as the stomach relates to the body—as the stomach provides fuel to the body for survival, a healthy economy requires the product fuel derived from robust production.

Next, a convertible currency depends on market recognition and government support to determine its value. Value is determined in true capitalist fashion: free market institutions set prices based on currency supply and established/perceived government policy and support for its currency. In this kind of forum, contrary economic information is enough to cause significant perturbations in the market prices for a currency. Thus, as nations depend on the value of their currency to establish worldwide price for traded goods, so convertible currencies depend on currency exchanges for market determined value.

Similar to currency/currency exchanges interrelationship, all aspects of the trade system depend on transportation and its availability. Transportation methods can include railroads, highways/trucking, air transport, shipping, and any other manner in which

materials or products are shuffled between suppliers and markets. For example, industry relies on transportation systems—typically railroads and trucking—to gain access to raw materials and transfer product to ports.

Two distinct categories of banks impact the trade system: commercial and central (government) banks. While both are banks in the traditional sense, each carries out a different trade system role. Commercial banks fuel trade by making loans—for capital and industrial expansion and or for the purchase of goods and services. Commercial banks can also loan capital to nations in support of IMF policy and guarantees. In short, commercial banks are the major financiers and providers of capital for the world trade system. Central banks, on the other hand, play a smaller role in the physical trade system. They influence trade policy through the establishment of governmental monetary policy. Currency exchanges, for example, use central banks as barometers for determining the health of an economy. Central banks also establish loan rates for borrowing from the government which, in turn, affect the lending rates charged by commercial banks. Overall then, central bank policy can be thought of as a transfer of the intent of the individual government to the trading system.

Finally, both bond and commodity markets play infrastructure roles in the financing of trade at many levels. However, as explained in the previous chapter, targeting these globally linked institutions can have extremely negative effects on the nation conducting the intervention (or its allies). Thus, while lucrative, the probability of targeting these nodes is extremely small.

Population. Population includes the people who reside in the system—the people who make the system run and ultimately benefit from the system in some way. But just

listing a "people" node is too restrictive. Instead, in the case of the trade system, two overlapping classifications will be discussed: the labor population and the consumer population.

The labor population is many faceted, and composed of those individuals who work to develop the raw materials, to produce products, to operate the transportation systems, and a host of other functions. Essentially, labor can be defined as one of the key elements of an economy, without which the system could not exist.

Consumers are likewise important to an economy—without the market demand generated by individual consumers, the trade system would be forced to rely solely on governments for the purchase of goods. As such, traditional capitalist economies rely on an abundance of consumers to maintain the product market base.

Fielded Forces. Fielded Forces can be considered as those assets that physically protect all aspects of a country's trade system. Traditionally thought of in terms of the separate military service components, these can also include law enforcement or non-defense executive branch agencies. In the United States for example, the Coast Guard is an operating force under the jurisdiction of the Treasury Department.

Trade System Linkages

After identifying the nodal makeup of a system, the planner must continue his analysis to determine the interrelationships that exist between these nodes. These interrelationships or linkages can go in two directions. First, each node has other nodes within the system on which it depends. For example, the "industry" node depends on several other trade system nodes: raw materials, fuel/energy, and labor. In turn, each node has

other nodes within the system which depend on it. Again, using the “industry” node as an example, this node directly influences the product node.

In essence then, a country’s trade process can be thought of as nothing more than a complex set of nodal interdependencies. To effectively target trade, planners must understand the road map of interdependencies and identify those nodes upon which the great number of interdependencies, or linkages, exist. To identify these linkages an analytical tool called STRATEX (strategic exercise) was used. STRATEX identifies and quantifies the linkages between various nodes. It prioritizes the different nodes with respect to their influence on the entire system. Several trials based upon different assumptions repeatedly identified two nodes as critical to the trade system (Appendix B contains the output of one STRATEX run). These nodes were the communications and data networks between the parties involved in international trade. These nodes then become identified as the ones that are critical to the effective operation of the system, and by attacking these, planners can cause a cascading effect felt throughout system. More simply stated, by attacking these critical nodes, planners stand to realize gains many times the value of their efforts—in effect, a truly synergistic relationship. For example, influencing the data networks in the STRATEX model had a significant effect on the commercial banks which finance trade, the currency exchanges that enable trade, and the direct communication between buyer and seller, all of which had a cascading effect on the total volume of trade.

Centers of Gravity

Since von Clausewitz's initial center of gravity conceptualization,¹⁴ military theorists have continued to expand on his basic premise. In his book, *The Air Campaign*, Warden provides his views: "The term Center of Gravity . . . describes that point where the enemy is most vulnerable and the point where an attack will have the best chance of being decisive."¹⁵ Applying this definition to the analysis at hand, the issue becomes one of where will the attack have the greatest chance for success? In other words, although the critical nodes have been identified, planners must evaluate these in light of their capabilities to actually affect them. Therefore, although a node may be critical, it may not actually be a center of gravity unless the planners validate it as one.

Such validation is not a difficult process, and it essentially can be performed by evaluating a course of action against a set of six questions. First, is the node vulnerable to attack by using one of the instruments of power? If not, further plans to include this node should probably be avoided. Is attacking a critical node worth the potentially heavy losses that might be suffered? Next, will the attack on the critical node (and its resultant cascading effect throughout the system) have the desired result of achieving the planners' original objective? In the case at hand, by attacking a component in the trade system, can the planners be reasonably certain that the action truly degraded a given aspect of the enemy's economy? In addition to objective, risk, and vulnerability, the validation process should also examine the likelihood of collateral damage resulting from the original intervention. For example, if the Tokyo Grain Exchange was affected, what effect would this have on other global financial markets? Could the intervention rebound and wind up affecting commodities markets in the planners' country? Additionally, the speed or the

length of time required for the intervention to achieve the desired objective must be considered. Through the years, "slow" speed has often been blamed for the failure of economic warfare. Prior to Operation DESERT STORM, the US Congress hotly debated the effectiveness and potential of economic sanctions levied against Iraq. US leadership, worried about a fragile coalition, believed it did not have time to allow the sanctions to work, and turned instead to a military solution to achieve its objectives. Finally, world opinion has an impact on a country's willingness to proceed on a course of action against a specific target.

The critical nodes of communications and data networks successfully met the 6-question validation criteria. We currently possess both lethal and nonlethal technologies to affect, isolate, or sever the networks in the trade system. Second, there is a wide range of options available to the planner for attacking the stated nodes. Therefore, risk to the forces conducting the campaign was rated as minimal to moderate depending upon the type of weapons chosen for the attack. Third, given their dependence upon information technology, attacks against trade system networks stand a high probability of achieving the planners' objective of a cascading effect felt throughout the system. Fourth, collateral damage is a significant risk in any form of economic warfare, but depending upon the weapon chosen, can be minimized. Fifth, speed in attaining the objective, a traditional shortcoming of economic warfare, must be addressed. New technologies are emerging which overcome this shortcoming, and this paper will address those weapons in detail. Lastly, world opinion is not affected as severely as in more lethal forms of military warfare. In sum, the critical nodes of communications and data networks can be considered a valid center of gravity and are therefore worthy of attack.

Conclusion

The systems analysis methodology described over the course of this chapter can wind up being quite intricate in its final form. But for however complex it might seem, planners must never forget the subjectivity that it is based on, or, believing entirely in its worth, disregard other planning aids they have available.

Chapter 5: Operational Analysis of Trade System Centers of Gravity

The United States certainly does not lack the capability for conducting economic warfare, and has in the past used some of the more traditional methods—tariffs, import/export quotas, embargoes and blockades—with some success. However, if the strategic analysis reveals a higher dependence on communications and data networks than an enemy's military forces, the fundamental way in which warfare is conducted must be restructured to achieve the desired objectives.

The advent of new technologies brings with it many questions however. For instance, what constitutes a communications or data network? While most individuals can identify with telephone systems at home or computer networks at their business, the infrastructure of these types of systems goes well beyond the physical equipment that usually confronts the user.

Second, in addition to possessing the necessary technical sophistication, how dependent is the potential adversary on information technology for the day-to-day functioning? Harvard's F. Warren McFarlan has coined the term "Electronic Heroin" to describe this dependency, implying that addiction is the appropriate metaphor.¹⁶ Industrial sophistication is a poor proxy for this dependent relationship. "Even a primary industrial society such as eastern Europe is not an ideal target. If the information warrior's target can continue to thrive without its information infrastructure intact, it does not become an attractive prey."¹⁷

Additional questions are raised when one tries to identify what makes up world trade—what is it that countries import and export? Some sources list six basic categories

of trade (“manufactures, energy, food, raw materials, nonfactor services, and other services”¹⁸) while others divide trade into import and export categories, each having its own subcategories (food, industrial supplies, fuels, machinery and transport equipment, and consumer goods for the former; and agriculture; mining and quarrying; food, beverages and tobacco; textiles and clothing; and metal for the latter.¹⁹)

The specifics of categorical nomenclature aside, “agricultural” products, for example, made up 10-13% of the estimated \$4 trillion dollars of “physical” world trade in 1994—but returning to the dependency issue, are communications or data networks important to farmers or growers? Or to exporters? Or are communications and data networks only important to groups who finance each of these entities?

To clarify the analysis then, a study should be performed on each of the fundamental areas of world trade to identify the part played by communications and data networks. This process is best accomplished using operational analysis tools.

Finally, strategic thought must be applied to the means necessary to influence the particular communications and data network. While simple in the literal sense, the realities of the problem—in an age where collateral damage must be minimized—are somewhat more difficult.

Communications and Data Networks

Communications and data network architectures can vary considerably in their physical properties, layouts, and protocols. However, the basic functional components are relatively easy to understand. For example, connectivity between two offices (or nations, for that matter) can be provided by an untwisted pair (UTP) cable from the tele-

phone/modem to a wall connection/junction box, routed/bridged via copper cable or fiber optic line to a private branch exchange (PBX), and then out onto a copper cable or fiber optic transmission line for connection with the private branch exchange and router/bridge responsible for the receiving party's telephone/modem. (A router is nothing more than a switching device which passes traffic between a local area network [LAN] or client-server segments based on a specific communications protocol or address system, allowing various subnets to exist on a LAN.²⁰ A bridge can be thought of as an "intelligent" router which traffics data between LAN sites which use different communications protocols.²¹)

While the entire connectivity path can be thought of as a network, it is easier to breakdown this path in terms, for this discussion, of a LAN and a wide area network (WAN), with the latter providing the entire connectivity path between the two end users' systems interfaces (in this case, the individual routers or switches). Additionally, another point of distinction between the two area networks is that while many LANs are essentially private or site specific, many WANs utilize public or leased trunk lines. (A third type of architecture—the metropolitan area network, or MAN—has also been identified. From a macro viewpoint, consider the MAN to describe the total connectivity of LANs within a city, with WANs providing intercity connectivity.)

Both LAN and WAN arrangements are as varied as the number of user groups, businesses, offices, and the complexity of connectivity required. Advertising aside, no one network is "best" as individual networks remain a function of the number of system users, the number of peripheral devices attached, the interface required between components, the current available technology, and a host of other factors.

While the structure of communications and data networks have been discussed, it is important to realize that these only provide the “physical” half of the operating system equation. And in today’s day and age, their relative importance may be waning in relation to the software which drives the systems and performs the “actual” work. As Amy Cortese points out:

There is an enormous need for ‘enabling’ software—to speed up the transmission of huge video files, to guide you through hundreds of TV channels, to manage thousands of online transactions, and to make sure those transactions are secure. Software is king.”²²

To demonstrate the power of software programs over computers, peripherals, or network equipment, Alvin Toffler, in his book “Powershift,” details the following incident:

At 2:25 P.M. on the afternoon of January 15, 1990, engineers in Bedminster, New Jersey, noticed red lights flashing on the seventy-five screens that display the status of AT&T’s long distance telephone network in the United States. Each light indicated trouble. (This accident) added up to a massive breakdown in the U.S. long distance phone system lasting for nine hours, during which an estimated 65 million calls were blocked. AT&T investigators concluded that the breakdown resulted from a faulty computer program.²³

Cortese’s and Toffler’s views aside, it serves no purpose to address the importance of software over hardware. But what should be apparent to military planners is that all facets of a communications or data network must be closely examined when trying to identify the means available and the type and magnitude of desired intervention. Another way of looking at this with respect to communications and data networks is through the following model:

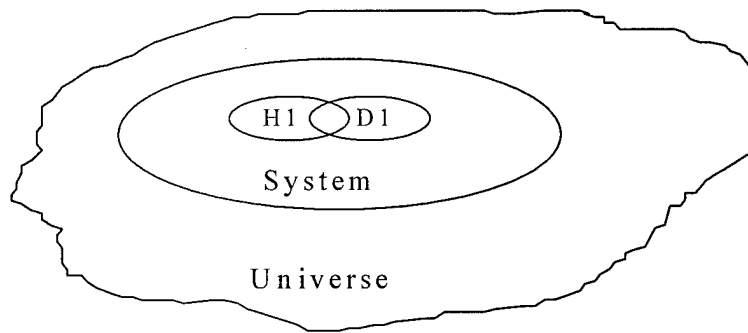


Figure 2. The Structure of Systems²⁴

In the universe of what's possible, a computer hardware or software designer "builds" a program or computer device. According to the designer's specifications, the system performs everything it is supposed to, that contained in ellipse D1. The fact remains, however, that regardless what they were designed for, most systems are capable of performing many other tasks as well; for example, the program or device not only performs D1, but additional tasks contained within the capabilities ellipse entitled "System." How small or large this System is might not be readily definable. What military planners should attempt to identify and exploit is the H1 ellipse—some capabilities of the original design, but mostly those capabilities of the System that weren't specifically identified or designed into the software or hardware, but remain there all the same.²⁵

Another example, software specific in this case, deals with programs called compilers. While a compiler is essentially nothing more than a "shell" program which translates application software to a language understood by the computer operating system,²⁶ they have the ability to "learn" the most efficient way given types of routines should be ordered. Consider then the possibility of a "genetically altered" compiler, which performs routine translation until it receives a specific yet innocuous set of instructions, or

reaches some downstream generation, at which point it alters how the operating system executes the application.²⁷ Similar to the example in the previous paragraph, there is no precise way to completely test a compiler program for things that the designer doesn't expect it to be able to perform.

Applications

Before more closely examining the interface between trade and data systems, several communications and data concepts need to be addressed. The first is that of a value added network (VAN), which can best be described through a simple example. Consider a business in the United States which is answering a request for proposal from a German firm. Although the American firm has a proposal ready for delivery, the proposal is written in English because no one in the firm speaks or writes German. But instead of hiring a linguist to translate the lengthy document, the American firm electronically transmits the proposal to an intermediate node. The intermediate node accepts the incoming file, translates it from English to German, and then retransmits the proposal to the German firm. The intermediate node, or VAN, added a certain value (the translation) to the incoming data stream and provided a recognizable and usable product to the end user. There are thousands of VANs in existence worldwide whose services range from translation as depicted above, to commercial banks that provide various financial services to customers (the automatic teller machine [ATM] being a prime example). One unique VAN example is that of a company in France that provides tailored packages of real time weather and road conditions to operators of trucking firms. The trucking firms can then

transmit this information via specialized mobile radio (SMR) to their drivers, who can plan the most efficient routes for delivering their products between waypoints.²⁸

Second, the concept of electronic fund transfer (EFT):

... any transfer of funds, other than a transaction that is originated by a paper instrument, that is initiated through an electronic terminal, or telephone, or computer or magnetic tape and that orders or authorizes a financial institution to debit or credit an account.²⁹

To tie these two terms—VAN and EFT—together, consider the ATM to be a financial institution's VAN for allowing customers to conduct EFTs.

A third concept is that of electronic data interchange (EDI). In its simplest form, EDI is an electronic messaging system between a service provider and a customer. It allows a business, using its software and data system, to interface with a supplier—with its own software and data system—to place orders, get pricing information, shipping information, and the like. While in a sense, EDI can be viewed as a value added service, most current configurations are driven by software or hardware devices which are added directly to the local networks of both consumer and supplier. (The days of the “proprietary” computer network—where a company had to purchase all of its equipment from a single supplier to make the network work—are over. “Increasingly, consumers are demanding open systems that allow them to more easily interconnect their [existing] hardware.”³⁰)

The purposes behind EDI are severalfold: a) replace paper and verbal communications with electronic messaging; b) centralize record-keeping; c) allow for an instantaneous “snapshot” of an organization with regard to orders and invoices; and d) provide organizational efficiency by monitoring cost and inventory control.³¹ However,

EDI doesn't just impact manufacturers and buyers; its has deeper ramifications, especially for the financial services industry:

... at its ultimate extension, EDI approaches electronic funds transfer (EFT), the process through which banks move funds from one account to another or from one bank or banking location to another ... EDI allows a buyer to authorize its bank to transfer funds to a seller; both use the bank as a clearinghouse. Corporations with EDI networks could continually net transactions between themselves and their suppliers and customers who connect to the network, and only at the end of the day authorize final net funds transfer through the banking system to settle the day's business. In this case the bank would be providing little or no value-added service and might charge only "commodity prices" for passing money through its system.³²

Because of the lucrative nature of a fully linked EDI network, many banks are seeking entry into this service delivery market. Although bank-related "proprietary" messaging systems are currently used (e.g. SWIFT [Society for Worldwide Interbank Telecommunications] and CHIPS [Clearing House Interbanks Payment System]), none of them provide the connectivity required for global interface as does EDI. (Technically, both SWIFT and CHIPS are messaging systems versus electronic fund transfer systems. However, within the international banking system for SWIFT and the national banking system for CHIPS, both are recognized as legal instructions for transferring funds between accounts/banks.³³)

While the previous paragraphs have discussed direct interaction between consumers and suppliers, there are several other important functions played by communications and data networks within the trade environment. Of these, automated databases and electronic bulletin boards are the most prevalent. Some of these, and their functions, include:

1. US Department of Commerce Economic Bulletin Board—contains daily leads concerning trade opportunities, and information on export controls, industrial production, currency exchange, labor statistics to name but a few.³⁴
2. Trade Data Exchange—provides industry and sales data, foreign investment data, customs rulings, and the like.³⁵
3. Intellibanc—an export market intelligence network that specializes in agricultural products; also provides information concerning international trade fairs and symposiums.³⁶

Some of the trade information services can also provide customized products for subscribers. One of these, Trade Watch International, can create specific import-export reports culled from the most current statistical data available.³⁷ Another sponsored by the United Nations, is the Global Trade Point Network, which seeks to “use computer and telecommunications technologies to help companies pick up international trade leads, navigate trade regulations, conduct business transactions and arrange for shipping and payments. It especially aims to open the developing countries to global markets.”³⁸

Final consideration should be given to the dynamic role played by communications and data networks in financial markets other than EDI and EFT. While the market principles of buying and selling stocks, bonds or futures contracts are relatively simple and straight forward, the amount of information available for both buyer and seller to make their decisions and the speed at which transactions occur demonstrate the magnitude and influence of network systems.

For example, Buyer A wants to purchase 100 shares of XYZ Corporation at the current market price. He can call his broker and get the most recent price, or he can log on to one of the many VANs that list current prices. When satisfied, he notifies his broker, who passes the customer's order to the applicable exchange. Conversely, Seller B, using a home computer tied into his broker's VAN, has passed instructions to sell 100

shares of XYZ Corp. Depending on the specific market, both orders could simply be passed to a central computerized order exchange system, where they are matched (as is the case with stocks listed in the NASDAQ or Over the Counter market). In the case of a stock exchange like the New York Stock Exchange, the orders are routed electronically and processed either directly by the trading firm's floor broker or by the exchange's SuperDOT trading system (which is overseen by an individual stock specialist). After a buyer and seller are matched and the order is executed, a clearing corporation compares the buy and sell prices and establishes the trade's validity. After validity has been established, the seller's broker provides the sold shares to a central depository, which credits the seller's account and debits the clearing corporation with the sold shares. The central depository also receives money from the buyer's broker, and credits the clearing house with these funds. Following receipt of funds, the clearing house authorizes the shares to be debited from its account and passed to the buyer's broker, thus completing the transaction.³⁹ Essentially everything in this example, from the ways in which buyer/seller instruct their brokers to the clearing house functions of crediting and debiting, are performed by communications and data networks using electronic instructions.

Interrelationship with Trade

With the understanding that information technology can be found in widespread use throughout all sectors of national economies, how can communications and data networks be influenced to achieve a desired effect? Whereas Warden's 5-ring model allowed a systematic review of trade in its entirety, another tool—operational or nodal

analysis—can help to pinpoint more specific locations where an intervention can actually be applied.

For example, assume that Country A and Country B are neighboring states, each having essentially identical trade infrastructures as well as having significant levels of agricultural products being exported to common market locations in Country C. Also, assume that relations between Countries A and B are strained because Country B is not complying with the subsidy provisions of an international trade agreement—as a result, its farmers have a financial or market advantage over farmers in Country A. As a final initial assumption, although Country A has brought the illegal subsidy issues to international attention, nothing is being done to resolve the problems and local diplomacy efforts have failed. Country A believes that it should take some form of action to resolve this issue, but wants to take these measures short of provoking armed conflict with its neighbor and damaging its trade relationship with Country C. Where should it conduct an intervening action?

In performing an operational analysis, Country A's planners attempt to model the interrelationships of Country B's entire agricultural system (Figures 3-8).

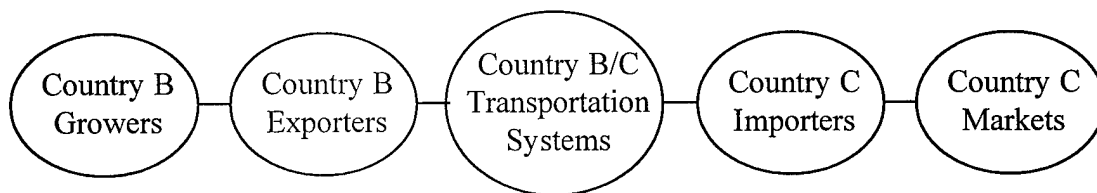


Figure 3. Nodal Analysis of Country B Trade

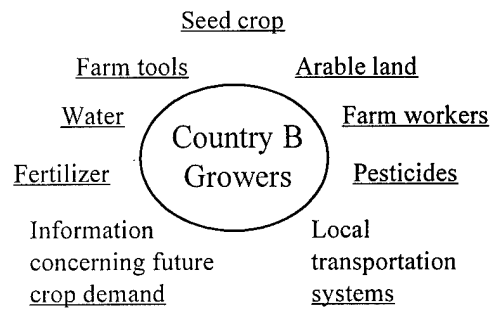


Figure 4. Nodal Analysis of Country B Growers

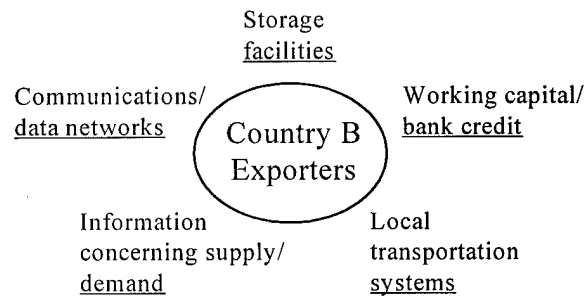


Figure 5. Nodal Analysis of Country B Exporters

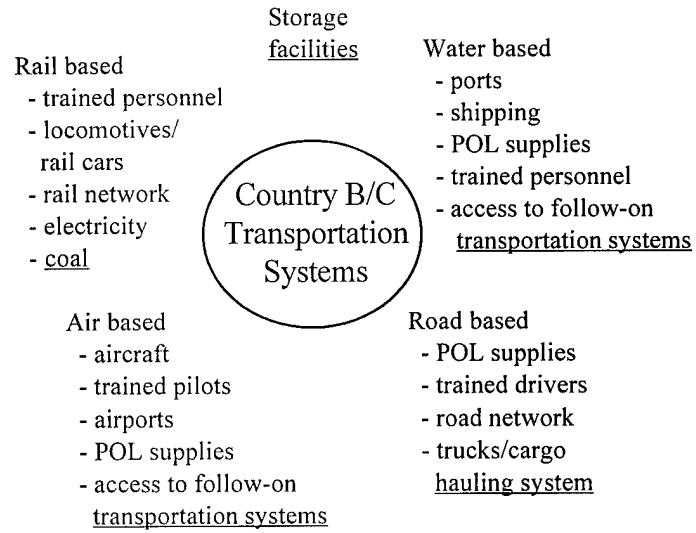


Figure 6. Nodal Analysis of Country B/C Transportation Systems

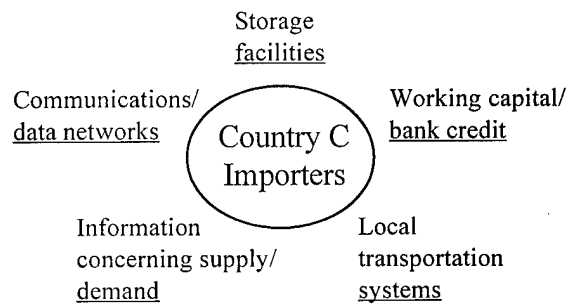


Figure 7. Nodal Analysis of Country C Importers

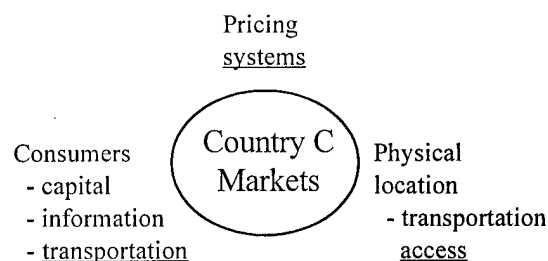


Figure 8. Nodal Analysis of Country C Markets

Subscribing to the belief that communications and data networks provide the critical links in trading systems, the following possibilities can be seen:

1. Farmers/growers. Low vulnerability as reliance on communications systems limited to information concerning actual farming. Significant number of databases available which can provide identical information. As a result, each farmer's data or communications network connectivity would have to be affected.
2. Exporters. Full range of vulnerability due to nature of exporter's business craft. However, dependence on communications and data systems seen through:
 - a. Identification of potential customers/markets using trade databases. However, the number of available databases—identified previously—equates to limited vulnerability in this application.
 - b. Arranging financial transactions through banking systems. High vulnerability if financial transactions are conducted using Country B assets only. Conversely, the risk of collateral damage increases dramatically if financial arrangements conducted transnationally.
 - c. Local inventory/storage/shipping databases. Can be highly vulnerable to selective intervention.
3. Transportation systems. Full range of vulnerabilities as evidenced by:
 - a. Warehousing inventory databases, which are vulnerable to selective intervention.
 - b. Transportation manifest manipulation, again vulnerable to selective intervention.
4. Country C importers. Possibly vulnerable to intervention if they have direct financial arrangements with or receive financing through banking systems in Country B. (The Export-Import Bank of Japan [JEXIM] is one example of an organization which will finance importers of Japanese products in countries with emerging markets.⁴⁰)

5. Country C Markets. Possibly vulnerable to information campaigns. However, with limited effect on Country C as a planning consideration, third party markets not likely to be the intervention location.

On the periphery of the operational analysis as well are the indigenous telecommunication systems which provide the physical connectivity within Country B. While not depicted, these can prove to be equally lucrative "hard target" intervention points, again depending on the redundancy that Country B has built for itself. As such, some key components could be Country B's PBX sites, microwave relay towers, submarine cables, and satellite communication uplink/downlink facilities. (At present, most countries have a single nationalized telecommunications network, where the government oversees and regulates the only communications monopoly. In fact, less than 10 countries worldwide permit competition in communications service markets.⁴¹ However, as occurred in the early 1980s with the divestiture of American Telephone and Telegraph into seven regional Bell operating companies [RBOCs], the demand for competitive pricing and service might result in other countries reevaluating their internal policies.)

The strength of the operational analysis process in modeling a specific country aspect (in this case, agricultural trade) is that the basic model equally defines other cases within the same country aspect. Say, for example, that instead of agriculture, the subsidy issue dealt with textiles. While subnodes might be somewhat different, the nodes themselves remain relatively constant. (Obviously, in this case, "textile producers/industry" would have to be substituted for "farmers/growers.") But in the end analysis, the model framework adequately describes the market process regardless of the commodity in question and thus demonstrates its worth to military or political planners.

The Future of Trade

As the 21st century dawns however, planners must consider the shift in historical trade categories; while agricultural products and textiles were symbolic of international trade (and might still depending on the wealth—or GDP—of a nation), these traditional categories of trade are being replaced in some countries:

It is interesting to note that in 1991, American companies for the first time spent more on computing and information technologies than on mining, manufacturing and farm equipment. Indeed, we are now seeing a shift in trade from 'merchandise goods' to services (and struggling in the process with how to measure that.) While overseas sales of physical products—computers, semiconductors, etc.—will continue to expand, the fact is that exports of communications and information services, including software, are growing faster, and now account for over one-third of all technology exports.⁴²

Equally important, "financial" trade should not be overlooked. In his essay, "From Bretton Woods to Global Finance: A World Turned Upside Down," Eric Helleiner notes that

private international financial activity has grown at a phenomenal rate . . . by the late 1980s, the volume of foreign exchange trading had come to total \$650 billion dollars per day, exceeding that of ("physical") international trade by nearly 40 times.⁴³

Although stock markets were discounted as part of the original analysis, it could be that financial instruments—index futures, Treasury bills, and stocks—might substitute for or replace what was previously thought of as import and export trade merchandise.

Acknowledging then both the growing volume and financial importance of communications and data networks and pecuniary trade, the question becomes whether these types of systems should be considered as the likely intervention points in future conflicts against countries considered to be "more developed." While on face value,

bringing a country to its knees by contaminating its commercial or central banking system with a computer virus appeals to the bloodless nature of conflict demanded by the "smart bomb" generation, it is in most cases easier to say this than to actually carry out such a plan. For example, as financial traders in Singapore electronically link with markets in London and Hong Kong to purchase contracts for US Treasury bond futures, an intervention in one of these three locations could have a cascading effect throughout the entire global financial system. Is the intervention of such importance that the potential risk of collateral damage can be ignored?

A second issue concerns the abundance of moderately priced technology. Any country that relies on communications and data networks generally has sufficient backup facilities, or hot sites, in place which form a redundant second dimension to their networks. While intelligence capabilities should be able to locate the primary networks, the alternate networks are normally situated in more secure locations. As a result, trying to deny an enemy the use of his technology may or may not be a likely possibility.⁴⁴ (Some benefits may be achievable. Depending on how these alternate networks are linked to the primary system, delays might be experienced while transitioning between the two, generating operational down time. If the country is truly addicted to its networks, this may meet the attacker's objectives. Another important consideration here is the number of organizations currently relying on similar back up services. Theoretically, the greater the number of concurrent users employing each of these, the more likely that these networks themselves will be overloaded, either causing longer processing delays or failures of the back up services.⁴⁵)

Finally, as technology becomes more advanced and networks become more intelligent, some systems may have the capability to identify attempts at intervention and “repair themselves.” The easiest example of this is a standard software program which conducts checks for viruses either periodically or in the event normal connectivity is disturbed, thus neutralizing the intervention attempt.

But for however many “what ifs,” this argument should not lead to the conclusion that financial systems are “too hard of a target,” or that conventional types of ordnance (even precision guided munitions) do not have a place in the planners’ toolkit. Rather, as was the case with Country A and Country B, planners must systematically analyze the target system and discern the presence of those links which, if affected, will maximize the desired impact of the intervention. Knowing these, they can selectively apply their capabilities for a desired effect.

Conclusion

The preceding pages have come a long way in describing the nature of trade and the significance of communications and data networks to the trade system. While “physical” trade certainly provides the goods required for basic safety and security needs, it has been shown that in recent years the emergence of electronic trade in “financial” imports and exports has come to dwarf its physical family member. Additionally, a basic model was described demonstrating how planners might break down a trade system center of gravity to logically determine the preferred intervention sites.

The question that remains, however, is what forms of intervention (weapons) can planners count on using against an adversary’s communications and data networks in

order to achieve their desired objective? The answer, as well as the equally important issues of how this kind of warfare will be conducted, will be examined in the next chapter.

Chapter 6: Targeting Communications and Data Networks to Influence Trade

Building on the premise that the most vulnerable point in an adversary's trade system is the communications and data networks over which global trade is conducted, focus can now be shifted to the specific process of influencing, degrading, or destroying them. Current literature centers on the epidemic of computer viruses and the effect they can have on networks. It hypothesizes that in the hands of a high tech terrorist group, information weapons could prove devastating to the computers that support banks, stock and commodities markets, and foreign currency exchanges. Considerably less information exists regarding the coordinated employment of these weapons in a comprehensive, economic campaign against a chosen enemy. This portion of the paper will show that cyberwarfare, a phased campaign against an adversary's information technology systems, has the potential to become a valuable national instrument of power capable of disrupting an enemy's trade capability and ultimately, its economy. It will build a framework for conducting a time phased cyberwarfare campaign against part or all of an opponent's trade system. And hopefully, it will begin the debate from which a cyberwar doctrine can be developed and refined.

Intelligence Gathering Activities

Cyberwar can be used to collect intelligence information about a targeted country's trade communications network. The first intelligence phase, external intelligence, is a non-intrusive data collection period that attempts to model a particular network that appears vital to the conduct of trade. Of particular importance are the points

of intersection and the interrelationship of the components of the system. Questions to be answered in this phase deal with the systemic nature of the network. Who administers and controls access to the network? From what sources does the network draw electrical power? What data storage and processing capabilities exists? Does it connect to other networks? What physical components (fiber optic lines, satellite links, telephone systems) make up the system? Who are the primary users? What security measures exist to protect the network?

Fortunately for planners, many networks were built before security became a prime concern and are not difficult to study. Also, considerable off-the-shelf sources of intelligence are available. Many networks freely disclose their architecture to other members of the information technology (IT) community as an incentive to use and develop after market products for the network. In addition, the International Standards Organization (ISO) touts the open systems interconnection (OSI) architecture, available in the public domain, as the international standard for all future telecommunications systems.”⁴⁶ The intelligence gathering effort is limited only by the imagination. Garbage dump sites appear to have great intelligence potential. One noted hacker attests to the ultimate value in “sorting through the dumpsters of giant Microsoft Corp.”⁴⁷ Michael Higgins of the Center for Information Security Systems of the Defense Information Systems Agency tells of a ploy where unsuspecting members of an organization are called by bogus technicians and told that the current manual for their network has serious flaws in it and that a replacement is on the way. In the meantime would they please put the current manual in the trash.⁴⁸ Finally, history has shown that the greatest source of

intelligence on a system may be its users who willingly, either in revenge or in an attempt for self-aggrandizement, reveal the system essentials to anyone willing to ask.

Using the information gained in the external phase, the intelligence collection effort moves into the internal or penetration phase. Analogous to special forces units penetrating enemy areas to gather information, in this phase the attacker will actually gain access to the system. In "cyberspeak," the goal is to break through the "firewall," or the electronic guardian designed to keep unwanted or unauthorized users away from an organization's precious data and operating networks. Relying on passwords, keys, alarms, and other devices to prevent intrusion, firewalls do not always perform their function, and penetration is usually possible.⁴⁹ Several tools currently exist to make the task of unauthorized entry easier. One of the favorite tools the system penetrator uses to steal passwords is known as the Trojan horse.

As in the historical account of the War of Troy, the Trojan horse has a disarming, harmless outward identity that conceals a sinister purpose within. Trojan horse programs are designed to impersonate legitimate programs. One found regularly on college LANs is a fake Novell Network Login EXE program which prompts the user for an identification and password during login. It then stores the information to a secret area within the computer workstation. . . . The Trojan horse then disables itself and restores the legitimate login.exe program.⁵⁰

Another tool in the cracker's kit includes software called sweepers. With unlimited patience, a sweeper generates a random password and attempts to gain access to a network. If unsuccessful, the process is repeated. Sweeping can continue against a network almost indefinitely.

Once past the firewall, the attacker will usually go to the network's command center. Using off-the-shelf software known as a "rootkit," the penetrator can seize

command of the network at the root or supervisory level. At the root, the attacker gains several advantages.⁵¹ He can install a backdoor log-in, an invisible method of gaining access to the system anytime desired. Root also allows an outsider full access to all diagnostic software on the system, giving an excellent detail of the entire network including any areas of security weakness. Finally, with root access, the penetrator can install any software to make the surveillance effort more effective. One particular favorite is the sniffer. These programs perform electronic eavesdropping, monitoring the information flowing along the network and telephone lines.

One interesting source of data for the sniffer comes from the terminals themselves. When in use, these devices emit electromagnetic radiation that can be reprocessed with relatively simple equipment to recreate and store the information. First identified by the Dutch scientist Wim van Eck, the radiation is appropriately called van Eck radiation. The potential to the enterprising sniffer is obvious. "The computer screens that we once thought were private are, in fact, veritable radio stations. The keyboard strokes that we enter on our computers are also transmitted into the air and onto conduit pipes and power lines."⁵²

At this point the unique capabilities of airpower become apparent. Aerial electronic reconnaissance and collection of electronic signals (signals intelligence or SIGINT) is one of the fundamental missions currently accomplished by aviation platforms. The adaptation to sniffing appears relatively straightforward. Airborne platforms could be used to intercept data being up or down linked to satellites or transmitted by microwave ground relays. Van Eck radiation appears to be a particularly lucrative target. Van Eck himself estimates the reception distance to be on the order of one kilometer.⁵³ With its

flexibility and standoff capability, airpower employed in this phase appears particularly promising.

The final step in the operational analysis is to transform the raw data into a usable product. The data must be analyzed, categorized, catalogued and deposited into a central data base, accessible to all members of the attacking force. The intelligence collection is organized into a pull system, providing information on demand by the user. Once the intelligence collection effort is accomplished, the planner has an electronic map showing all critical system components, entrances and exits, and areas of poor security on a digital "Rand McNally of cyberspace."⁵⁴

The end result of the operational analysis will be the selection of the center of gravity that will affect the entire system. A classic example of a center of gravity for a small state would be the computer networks supporting a central bank. Intervention at this point would affect the source of financing for commercial banks, the management of the national currency, or the ability to underwrite national trade ventures. Note the cascading effect. Peter Black underscores this stating "The easiest and cheapest way to attack a banking system is to harm the computer-communications systems upon which it is founded. Choose the right electronic funds transfer system, damage it in the right way, and the ripple effect can be massive. . . ."⁵⁵

Determining the Desired Effect

In this phase, the knowledge of the system is wedded to the objective by affecting the center of gravity. Desired effects from cyberwar can range from a psychological state of fear in the mind of the target's population, to an operational effect limiting a target

state's ability to use its economic instrument of power to the ultimate effect of strategically paralyzing a nation. In addition, the effects of cyberwar may be further classified by depth, deniability and duration. Depth describes the degree of intrusion and gives cyberwar its impressive flexibility. When considering depth, the degree of intrusion may range from:

1. Invisible monitoring of the system. Without ever making his presence felt, the planner can use information warfare as a means of economic eavesdropping on an adversary. Just as code breaking capability gave the US a distinct advantage in the war with Japan, information on economic capability and intentions can prove invaluable when attempting to disrupt the trade system through more traditional means.
2. Confusion among those that use and rely on the network. This is the lowest level of impact on the system, and to the user, things do not appear quite right. Frustration and loss of confidence in the system result, and some processes are slowed. The user doesn't suspect infiltration since "it is a fact that odd behavior is usually not caused by viral penetration. Software bugs, user errors, and hardware failures are much more common."⁵⁶
3. Suspicion that the system may be under attack. This is a psychological ploy against the managers of the network and often results in self-induced effects. In an effort to locate a possible problem and prevent any further damage, system operators may intentionally remove large portions of capability from a network. The effect can be rather extensive, as trying to find a piece of malicious code has been compared to trying to find a typographical error in the New York City phone book.
4. Alteration of data. In an environment that stores money in the form of 1s and 0s on a magnetic disk, any alteration of data has profound consequences. The impact here ranges from bogging down the system so that all data can be verified from paper records, to the loss of customer confidence in the network.
5. Loss of data. An amplified version of the previous objective.
6. Disabling part of the network. Up to this point, the network still functions properly, although the results are somewhat suspect. With this effect, capability is reduced. Current information warfare weapons enable the planner to disable any part of the network including storage, and data transmission capability.
7. Degrading or incapacitating an entire network that an adversary relies upon in the conduct of international trade. Examples include degrading the networks used to electronically transfer funds or convert foreign currency.
8. Impacting the import or export of a specific product or commodity. This is especially fruitful in those nations that rely on the import or export of a small number of vital products for their economic health.

9. Complete incapacitation of the economic system.

Deniability refers to the degree of anonymity that can be maintained by the attacking force. Unlike his physical counterpart, the cyberspy has several forces at work to ensure his actions remain clandestine. Foremost among these, is the difficulty separating the attempts of a 16-year-old hacker from a serious attempt at cyberwar. Internet author Michael Wolff recalls that attempts at penetration are commonplace. "Every morning we find pry marks from people trying to pry open the firewall."⁵⁷ Higgins expands on that by asking if you have 27 kids attacking, how do you know the 28th isn't an organized attacking cyberforce?⁵⁸

Even with the latest safeguards, unauthorized network penetrations are increasing at an exponential rate. Higgins estimates that unauthorized entries to unclassified defense systems alone are on the increase of about 135% per year.⁵⁹ Even more astounding is that over 96% of all penetrations will go undetected, and of those that are detected, over 95% will go unreported.⁶⁰ Why do so many clear computer security violations go undocumented? The answer appears to be grounded in fear. First, the system operator may fear retaliation by his own organization for allowing the penetration to occur in the first place. In addition, the system operator may fear retaliation by the intruder himself.⁶¹ Compounding the situation, even if an entry is investigated, the audit will rarely result in a successful trace. Higgins relates that "every time you cross a country boundary, you make it virtually impossible to track," and with the thousands of worldwide Internet nodes, crossing national boundaries is so simple that it anonymity is essentially guaranteed.⁶²

The final subclassification of effect is duration. How long will the effect last? Cyberwar allows the planner to choose from a variety of effects ranging from permanent

damage to hardware components to those that are self eliminating and exist for a relatively short period of time. The effects in-between are limited only by the planners' objectives.

Selection of the Target Set

The selection of a target set embodies the operational art of warfare, and depends entirely upon the insight of the planners. However, Hust offers a review of five generic components that may aid the planner with the analysis.⁶³

1. Switching centers. Refers to the centers that accept and reroute both voice and digital information through the phone system. The switch is a vital component and is "often highly automated, unmanned (or lightly manned) and remotely monitored."⁶⁴ With control of the switch the planner has access to all phone conversations and has the capability to reroute calls to any to any area of the network.
2. Management and Control facilities. Includes the leadership element of a network such as system operators and technical specialty branches.
3. Multiplexing facilities. Multiplexing is the technique of altering the timing of signal transmissions to permit one channel to transmit several signals without the threat of interference between them.⁶⁵
4. Transmission Medium. The three primary media for attack include telephone land lines, radio microwave relay systems, and satellite transmission systems. As will be discussed, application of airpower appears particularly promising against this area.
5. Amplifiers and repeaters. Regardless of the composition of the transmitting cable, wire, or fiber optic, at least a few amplifiers must be in place to boost signal strength as it propagates along the network. Without these repeaters, the information would be unusable.

Force Application Planning: Weapons Development

Up to this point there have been strong parallels between classic military operations and cyberwar. In both cases, intelligence information is gathered and a strategic and operational analysis of the enemy as a system is conducted. During the next phase, weapons development, the similarities begin to diverge. While conventional weapons may take several years to design and field, the weapons of information warfare

can be created in a matter of days. Two particular categories of customized weapons, malicious software code and counterfeit chip products, merit further discussion.

In November of 1988, Robert Morris, Jr., a 23-year-old graduate student at Cornell University, demonstrated the effective potential of cyberwar when he launched an attack against the Defense Advanced Research Projects Agency (DARPA) network known as ARPANET. The virus quickly spread to another network, MILNET, seriously impeding both. The Morris virus

released a small army of surreptitious programs. One instructed the computer to make hundreds of copies of the original program. Another searched out the names of the users with legitimate access to the system and identified their secret passwords. A third told the computer to send copies of the original program to every other system on its electronic mailing list.⁶⁶

Clearly malicious code can be considered a weapon in every sense of the word.

Malicious code can take several forms, and the best known of these is the probably the virus.

The essential component of a virus is a set of instructions which, when executed, spreads itself to other, previously unaffected, programs or files. A typical computer virus performs two functions. First, it copies itself into previously-uninfected programs or files. Second, (perhaps after a specific number of executions, or on a specific date) it executes whatever other instructions the virus author included in it. Depending on the motives of the virus author, these instructions can do anything at all, including displaying a message, erasing files or subtly altering stored data. In some cases, a virus may contain no intentionally harmful or disruptive instructions at all. Instead, it may cause damage by replicating itself and taking up scarce resources, such as disk space, CPU time, or network connections.⁶⁷

The latest generation of viruses make themselves particularly difficult to detect or disinfect. A stealth virus hides the modifications it has made to a system and will usually go undetected by anti-virus programs.⁶⁸ Polymorphic viruses alter their forms with each

generation of replication. Through the use of polymorphic engines, the virus uses a scrambling routine to change bit patterns each time it infects another site, making themselves invisible to scanning and protection tools.⁶⁹ Armored viruses use special tricks to prevent anti-virus experts from ever tracing, disassembling, or understanding their code and therefore prevent any type of anti-virus protection.⁷⁰

Computer viruses are not the only form of malicious code a developer can create. A worm, as opposed to a virus, does not require a host. Instead it crawls through a network and is specifically designed to change its location to avoid detection. Eventually the system becomes overloaded. The use of worms to attack a trade data network appears promising: "A worm might be preprogrammed to slightly alter numerical databases, such as rounding off figures, moving decimal places or occasionally replacing digits at random."⁷¹ Another, the rabbit, is a program designed for unchecked replication to exhaust some part of the system such as computer processing unit (CPU) time or disk space.⁷² A third, the logic bomb, is a software program that resides inside the target's network patiently waiting and looking for a predetermined condition as its trigger. This trigger may be a certain keystroke or condition that energizes the virus into an active, destructive mode. The latest generation of logic bombs incorporate the use of artificial intelligence (AI) to selectively identify and destroy very specific targets. The digital version of a precision guided missile, the AI logic bomb limits collateral damage. The benefit to planners is enormous. Inserted into a major banking network, the logic bomb could be programmed to seek out and attack the account of an specific importer or series of influential exporters without damaging the integrity of the rest of the network. Finally,

a time bomb is similar to the logic bomb but is programmed to attack at a certain time or date.

The spectrum of customized weapons available to disrupt a network is not limited solely to code. The basic building block of any network is the computer chip. In the process of "chipping" a designer creates a special counterfeit chip which mimics all the functions of its peaceful counterpart, but adds a series of instructions that accomplishes the targeteer's goals.⁷³ In creative hands, the possibilities generated by chipping are remarkable. For example, imagine a chip that in addition to performing its required function in a system also had the added ability to "listen for van Eck radiation, then broadcasts the information to make distant reception easier."⁷⁴ Evidence exists that points to a possible use of chipping by the US government against Iraq during the Persian Gulf War. Supposedly a printer was sold to the Iraqis that contained a counterfeit chip that spawned a virus which in turn degraded Iraqi command and control computers.⁷⁵ While the authenticity of this story is questionable, the concept of using these counterfeit chips to achieve an economic objective remains valid.

Cyberattack

With an adequate arsenal of code, the process can now pause and take advantage of another characteristic of cyberwar—its unlimited patience waiting for an execution order to strike the target. Once the attack is underway, planners, depending on the objective, can choose from four general types of strike options. First, the attack may take the form of inserting the malicious code developed in previous phases. If the system relies on radio, microwave, or satellite relay, the second alternative of jamming provides

temporary incapacitation. Moving further along the effects spectrum, two additional methods of attack are possible. Artillery in the form of directed energy weapons can permanently disable internal system components. Finally, the use of precision guided weapons, both conventional and electromagnetic pulse, enable planners to permanently disable both hardware and software. While much of the work in these areas remains classified, the basic concepts of these weapons and the possibility of mating them to an airpower platform can be explored.

Beginning with malicious code, the virus or worm can be injected by the attacker, or unwittingly placed in the system by an innocent. Possibilities for injection include breaching and infecting the system directly (consider the possibility of using an insider or "mole") by infecting software sold to the target, infecting the home systems of employees that uses both the home and target system, or infecting the target's software development branch.⁷⁶

While these insertion methods have been well documented and operationally verified, they can prove difficult to accomplish, especially on protected systems. By using airpower, however, some of this difficulty can be circumvented. For example, in those networks that increasingly rely on electromagnetic transmission, the airborne platform is a strong candidate for virus transmission with several unclassified sources attesting to this method's feasibility. "LANs are using radio frequencies in increasing numbers and phone lines transmitting data are up and down linked as are wide area networks. Radio frequency interception is a nearly trivial task today. Using an intercept/transmit model, viruses can be injected into communication systems with relative ease."⁷⁷

Where the use of malicious code is deemed inappropriate or impossible, the targeteer may resort to the next form of attack, jamming, to temporarily incapacitate an element of the network. Although jamming "is usually understood to be the use of electronic interference projected at an electronic instrument such as a radio or radar dish, it can also be internal to the system . . . by introducing failure mechanisms such as harmonic disturbances."⁷⁸ The arguments for airpower in the jamming scenario are well founded. There are strong parallels with traditional airpower missions (such as suppression of enemy air defenses, or SEAD) that specialize in jamming enemy radar receivers. Jamming of satellite data links and microwave relays appears a logical extension. Furthermore, airpower adds a unique capability to the jamming mission. A satellite broadcast system can be hardened to become virtually invulnerable to ground based jamming threats and their inability to jam the downlink. Only an air- or spaceborne jamming platform can attack the downlink.⁷⁹

Finally, there exists still more powerful weapons to disable a network. Consider a gun that fires a concentrated high power radio signal against an electronic target that destroys the delicate internal circuitry and turns any data stored in the system "into as meaningless string of babbling bytes."⁸⁰ Known in scientific circles as a high energy radio frequency (HERF) gun, the weapon could rapidly disable phone systems, data processing storage, and relay capability. This idea is not new. The Federal Aviation Administration (FAA) is concerned with HERF effects on aircraft and databases the threat of high energy radiated electromagnetic fields.⁸¹ The US Navy inadvertently field tested this concept when one of its ships, transiting the Panama Canal, accidentally forgot to turn off its radar equipment, disabling or destroying nearby computers.⁸²

Again leveraging on the employment of airpower, an airborne HERF gun could quickly render a communications and data network unusable. Airpower provides aiming capability free of obstacles, has the capability to move the gun quickly along the ground station path before being detected, and could generate the power required by such a weapon. Diffusion of the beam form does not appear to be a serious drawback to airborne employment. Jeff Hecht has studied the use of beam weapons as early as 1984 and argues that diffusion would be manageable. At one kilometer, a 1-meter dish would be able to attack an area roughly 40 feet in diameter.⁸³

At the far end of the destruction capability spectrum lay the explosives. Through the use of precision guided conventional weapons, airpower has entered a new era. The accuracy now exists to selectively destroy distinct portions of a target with reduced collateral damage effects. Precision guided munitions offer the most immediate way to marry cyberwarfare to the current air campaign planning process. After determining the desired node of the communications or data network to be eliminated, it is targeted through the daily air tasking order. One of the most promising uses of a conventional warhead against a telecommunications network appears to be against the switches of the telephone system. Research has shown that if either the input or output lines associated with a switch are severed, the resulting imbalance seriously affects the capability of the not only the switch, but also seriously degrades the network the switch is serving.⁸⁴

Moving beyond conventional explosives, current technology allows an attacker to employ a different form of warhead—one just as devastating to electronic equipment, but doing so “without hurting people.”⁸⁵ An electromagnetic pulse transformer (EMP/T)

warhead utilizes the same method of destroying electronics as does the HERF weapon, but is orders of magnitude stronger. In operation,

“the warhead converts the energy of a conventional explosion into a pulse of radio energy, which can penetrate computerized weapons through antennas, wiring or other metal connections. If the pulse of radio energy is powerful enough and the internal components are not toughed to withstand the pulse, the pulse will disrupt or even burn out the electronic systems.”⁸⁶

A targeteer can permanently damage computer hardware. In addition, all software and data contained on floppy disks, hard drives, tape, and backup systems will be erased forever.⁸⁷ While current technological capabilities are estimated at five MW of power for five seconds, the next generation of devices would be capable of emitting more than 100 MW of power.⁸⁸

There is ample evidence in the unclassified literature of the use of EMP weapons in the early phases of Operation DESERT STORM. According to *Defense News*, military forces apparently used Tomahawk cruise missiles (TLAMs) to transport “a new class of highly secret, non-nuclear electromagnetic warheads during the opening hours of the Persian Gulf War to disrupt and destroy Iraqi electronic systems, including air defense weapons, and command and control centers.”⁸⁹

The devastating potential of EMP weapons against economic targets is very promising. Probable “EMP targets are key financial centers . . . This would cause incalculable damage to computer hardware and software associated with stock and commodities markets, banking, international currently exchange and pension funds. Rebuilding computer systems and restoring software databases from paper records would doubtless take many months.”⁹⁰ A series of EMP attacks against a target nation would

seriously impair the access to and transfer of funds, as well as the process of foreign currency exchange in any international transaction.

Media Exploitation

To this point the cyberwar campaign planners have tried to create the desired effect in a center of gravity that cascades throughout the economic system moving closer to the overall objective. The next phase of the attack, media exploitation, amplifies the psychological reaction to the attack. Note the contrast to traditional American warfare which historically tolerated and often feared the media. Now the media is welcomed to provide leverage to the attack and can be exploited in a variety of ways. For example, after completing the operational analysis of the target, sensitive information on the financial intermediary can be leaked to the press. The planners hope that "if the private financial records of a high roller at an investment firm or bank is given to . . . the Wall Street Journal, his entire company will suffer."⁹¹

Another possibility involves the manipulation of the economic target's data. The departure from normal operations will not go unnoticed by its customers, and by extension, the media. The reputation and credibility of the institution can suffer. Potential customers go elsewhere. Other international and domestic institutions, strongly suspecting the presence of cyberwar, refuse to conduct any business with the target for fear of contamination. Panic ensues. The entire economic target bogs down in paralysis, and with no method of transferring or exchanging funds, international trade is severely impacted.

This cascading is accelerated by the unstable nature of markets in general and the foreign currency markets in particular. Private foreign currency traders, in an attempt to maximize profit, will often sense a weakness in a particular currency and hasten its downfall in the pursuit of profit. Even with government intervention, a currency's slide is often unstoppable. Comparing these traders to sharks that "stalk the international scene for the merest whiff of weakness,"⁹² Deirdre McMurdy explains that "Once a country's currency is under fire, the ferocity and momentum of the attack frequently paralyzes the central bank."⁹³

Measures of Merit Analysis

The planning process began by explaining the necessity of clear objectives for the campaign. This final phase of the process comes full circle and attempts to measure the degree to which those objectives have been attained. The planner needs some form of yardstick to determine if the campaign is on the road to achieving the objectives, or if a mid-course correction is in order. Hust offers five measures which will provide this insight:⁹⁴

1. Grade of service. Determine the extent that traffic across the network has dropped as a result of your attack.
2. Range that information can be heard. For use when attempting enemy jamming. Measures the ability of transmission and reception across a relay node.
3. Throughput and delay. Throughput is the amount of data that passes over the network in a given time interval. Delay is the time between the transmission and reception of data. When eliminating nodes, planners can expect other nodes to compensate, reducing throughput and increasing delay.
4. Capacity utilization. Again, as parts of the network are eliminated, the remaining elements will increase in utilization. Understanding the percent of capacity of these elements will show the strain on the entire network.
5. Availability. Determines the overall functioning of the network. Is it available for use when needed?

Conclusion

When objectives of another state conflict with our own, policy makers can turn to several national instruments of power to eliminate this conflict. For a variety of reasons the economic instrument is often employed. Traditional economic attacks such as trade boycotts and embargoes have been attempted, some more successful than others, throughout our history. As progress and technology have bound the world into a global economy, the prospect for a new type of economic warfare has emerged. This new type of combat, cyberwarfare, seeks to infiltrate, degrade or destroy the telecommunications links between global trading partners, exploiting the dependence a target has on his information technology to conduct even the simplest forms of trade. This paper has attempted to provide a framework for such attacks. Building on the current conventional campaign planning model, it offers a concept of operations to execute the campaign. After defining the campaign's objectives, planners perform a strategic analysis to determine if the target state would be susceptible to cyberwar. If reasonable, several methods are used to operationally analyze the target state and find those information centers of gravity which must be affected to achieve objectives. The cyberwar arsenal is diverse, ranging from malicious code to beam weapons to a conventional and electromagnetic explosives. The use and exploitation of the media, itself a form of information warfare, further amplifies the effect of these weapons. Finally several measures exist to verify the effectiveness of the campaign.

Military history is replete with technological advances such as the machine gun and aircraft which provided a distinct advantage to the side that appreciated its capability to change the way war is conducted. With the advent of the computer chip and the global

information community, that time may again be upon us. Yet the combination of this new form of warfare and unique weapon systems raises several questions that must be addressed at the national level.

Chapter 7: Current and Future Concerns

While the previous chapters have presented statistical processes, systems analyses, and campaign planning methods, all of these presuppose that the military planners have some kind of strategic objective or political end state in mind to guide their planning. Sadly, however, this is not always the case; in some instances, the military planners themselves must discern from the “wheat and chaff” of political rhetoric what their leader’s true objectives are, and then translate these into attainable military objectives. The mixed results of past conflicts attest to the weaknesses of this kind of arrangement.

It is no wonder then that as the countdown to 21st century grows shorter, that the number of issues concerning the use of information weapons against another country grows longer. This is not to say that valid “military” targets shouldn’t be “information targeted,” rather, if conflicts tend toward bloodlessness or rely less on the application of traditional offensive military power, who should decide what cyberwar weapons are used and against what non-military systems?

Decision Making and Planning

The present day decision makers, the National Command Authorities (NCA), are defined as “the President of the United States and Secretary of Defense together or their duly deputized alternates or successors.”⁹⁵ Although the NCA have a wealth of resources at their disposal (including the National Security Council [NSC] with its statutory members and advisors), the fact remains that the NCA retains all decision making authority. But if the face of warfare changes, should changes also follow in the national

infrastructure for conflict decision-making? Another way of looking at this is that when one observes the military in action on the battlefield, a clear chain of command from soldier in the field to the NCA exists. But if conflicts are to be waged on an economic or information plane where the battlefield is a series of communications and data networks, who are the soldiers in the field and what is the chain of command they follow? Should the NCA in this latter application be defined as the President and the Chairman of the Federal Reserve System, or the President and the senior US Trade Representative?

Another point to be raised is the matter of whether anyone truly understands economic warfare from an information perspective. The Department of Defense (DoD) has a significant number of plans and engagement concepts concerning operations in areas where military action might be expected. In fact, DoD's plans can, on short notice, be modified to account for missions where no military planning had previously occurred. But what kind of planning takes place at other executive agencies? Does the Commerce or Treasury Department or the Federal Reserve Board—the agencies one would assume to have the best knowledge of national economies—have a series of plans for implementing modern economic warfare against a moderate GDP nation? Does the State Department? Regrettably, the answer in most cases is "Probably not." Although economically derived flexible deterrent options (FDOs) have been identified, they remain particularly vague in their specific definitions and applications.

Equally perplexing are the issues of who will build and how will the information weapons in the national arsenal be controlled? For yesterday's "special" weapons (nuclear, chemical, or biological) personnel security was significantly enhanced and access limited, and storage and handling measures were created to provide positive safeguards at

all times. But these weapons also required inordinate capital expenditures for special equipment, materials, and laboratories for their manufacturing, things that prevented even moderately successful countries from acquiring such capability. But the "special" weapons that could change tomorrow's world might require nothing more than a laptop computer with a modem and access to a phone jack. Are the hard drives or floppy disks that contain these weapons under positive control at all times? Can this kind of technology actually be put under lock and key?

Finally, there has been a recent rash of political and media fascination with the idea of creating a National Information Infrastructure which would allow citizens nationwide to have access on demand to an almost unlimited amount of information. From the traditional free market perspective, an entity such as this could result in more level economic and financial playing fields. From a political perspective, the nation could hold an almost instantaneous plebiscite, providing executive and legislative branches with the true "mood of the people." Socially, the ability to exchange information and ideas between people living in states across the nation might serve to educate and enlighten the population. But what is missing in all of this is a coherent strategy—from either business or government bureaucracies—to define how the infrastructure should be structured. While some information chaos might be acceptable, the gross level found today is not, with the result being that a nation becomes either gridlocked or too slow moving to advance in comparison to its economic peers. Further, if communications and data networks and cyberwar are allowed to be viewed as autonomous technologies, does the country risk a future transformation from democracy to technocracy? Equally, if

technology isn't controlled by the United States, does anyone want it controlled by another?

Conclusion

Although there are no easy answers to any of the issues addressed here, the disturbing fact remains that many of the questions themselves have yet to be raised for public discussion. Addressing these head-on, coupled with proactive leadership (possibly a new cabinet position charged with Science and Technology implementation and integration) and large scale public/private sector involvement, are the critical first steps required to develop the framework and course of action for the national use of information and the communications and data networks it employs.

Chapter 8: Conclusion

The purpose of this research has been to answer the basic question of how a nation can more appropriately conduct economic warfare. Specifically, it developed a framework for directing national capabilities against an adversary's financial centers of gravity to cause that nation to change its policies. The major contributions this paper has made to the greater body of knowledge is several fold. First, it demonstrates the ACSC Air Campaign Planning Model as a valid tool to organize a planners thoughts in order to develop a comprehensive and coherent economic warfare plan. It can be argued that past uses of economic warfare have not been thought of or executed as a total process which actually encompassed all the aspects of a military campaign. Second, a new model has been developed to help identify those country specific financial centers that have a strong correlation to GDP and thus potentially have the greatest impact on the economic strength of the country. By using the model, planners can focus their strategic analysis efforts. As a reminder, this model has its limitations and is not an end to itself. A detailed country analysis must still be performed in order for the planner to completely understand the country as a system. But the model should certainly help in narrowing those efforts. Third, the paper demonstrates how to conduct a systemic analysis of a financial center in order to find critical nodes and COGs. In order to limit the scope of this paper only one financial center, trade, was completely analyzed. Trade was selected because there appeared to be a strong correlation between it and GDP formulation for most countries tested by the model. Fourth, the systemic analysis identified what can be considered non-traditional critical nodes for the trade system. Instead of industry, energy or

transportation, the results of the STRATEX analytical tool identified communications and data networks as the critical nodes for nominal trade systems. Fifth, after it was decided that these critical nodes were COGs a new and innovative way to attack them was discussed. This new form of attack, cyberwar, applied nonlethal technologies against different elements of the critical nodes identified during the operational analysis. Finally, a thought provoking discussion was provided concerning the overall issue of cyberwar—on who really understands the conduct of cyberwar as well as the command and control process required to execute this kind of attack and the issues that must be resolved before it can be carried out.

Economic warfare has been an active part of US national policy actions against other countries since 1776. As countries strive for bloodless warfare, and as nations' economies become more interdependent with advances in transportation and communications technology, economic warfare will only grow in importance. This paper will add to the effort of conducting economic warfare more effectively and efficiently in the future.

Notes

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⁵ Ibid., 184.

⁶ See *International Financial Statistics* (Washington: IMF, 1994) for details regarding reporting criteria.

⁷ The SDR is a valuation that currently comprises the currencies of the so-called G5 nations (United States, Japan, Germany, Great Britain, and France). Prior to 1970 the SDR was simply equivalent to the US dollar. After the gold standard was deserted the IMF developed a "basket of countries" on which to base the SDR. The specific value of an SDR is determined periodically and is based on not only the market value of the currencies, but also the economic importance of the currency (and thus the country) to the world economy.

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- ²⁴ Ted Handle, interviewed by authors during visit to Los Alamos National Laboratory, Los Alamos NM, 28 March 1995.
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- ²⁷ Ted Handle and Roger Stutz, interviewed by authors during visit to Los Alamos National Laboratory, Los Alamos NM, 28 March 1995.
- ²⁸ Toffler, *Powershift*, 115-116.
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- ⁷¹ James W. Rawles, "The Viral Threat," *Defense Electronics*, February 1990, 63.
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- ⁸³ Jeff Hecht, *Beam Weapons*, (New York: Plenum Press, 1984), 170.
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APPENDIX A: Statistics

The common statistical tests used in the analysis of data are listed below. Additionally, the individual country regression analysis results are presented.

Terminology and Statistical Tests

Because many of the terms used in regression analysis are not widely recognized, a description of the statistical testing parameters is provided to allow for consistent interpretation of the test data. A brief synopsis follows:

Goodness of Fit. The goodness of fit (alternately, the coefficient of determination) statistic R^2 indicates the proportion of the dependent variable that is explained by the independent variables. The higher the reported value of the goodness of fit statistic, the more of the dependent variable that is explained by the model's independent variables. For example, an R^2 value of 0.95 indicates that 95 percent of the GDP is explained by the combination of the model's variables.

Statistical Significance of the Model. The F statistic provides a measure of the overall statistical significance of the model. In essence it is a measure of the confidence in the model's structure as related to predicted GDP values. The computed F statistic is compared to a standard value, known as the critical value, to determine the overall validity of the model. An F statistic value greater than the critical value indicates that the model can be considered statistically significant for explanatory purposes.

Statistical Significance of the Variables. While the model may be statistically significant overall there may be variables within the model that are not. Inclusion of a

variable that is not statistically significant may result in problems with reported statistical test results of other variables due to cross relationships. Using the t -test, the significance of each variable can be resolved. The t statistic is determined by the ratio of the estimated coefficient of the variable to the standard deviation (a measure of dispersion). The computed value is compared to the critical value as determined from statistical tables. A computed value greater than the critical value indicates that the variable is statistically significant. This test is used to determine those variables that are significant in the determination of GDP for a particular country.

Examination of Residuals. The Excel software¹ program provides a graphical depiction of the error term for each independent variable. These error terms are plotted and examined to determine if there is a distinct pattern indicative of heteroscedastic tendencies.² Adjustments to the model based on the determination of this phenomena are subjective and resolve the statistical process to an art form to determine the correct specification for the variable. Essentially, if it can be ascertained that a significant pattern in the plot of the error terms exists then the model can be adjusted accordingly to account for the pattern. Heteroscedastic evidence implies that the regression model violates the fundamental linear regression assumption of constant variance of the error term.³ Each of the independent variables contributes to the error term in the estimated least squares line and a visual inspection of the plots of the residuals is commonly used to determine if the condition of equal variance is violated. Adjustments to the model are required as a result. Depending on the pattern observed the specification of the variable will also change. While the central hypothesis that financial center variables are related to GDP may be true, the exact nature may vary from country to country.

Multicollinearity. For each set of summary statistics a correlation table is provided. The values in the table indicate the correlation between two of the independent variables. If two or more independent variables are highly correlated, the regression model is unable to separate the individual effects of each on the dependent variable. For purposes of this analysis, variables were considered to be highly correlated when the absolute value of the correlation statistic exceeded 0.50. Solutions for the problem of multicollinearity include elimination of one variable if it is not statistically significant, or combining the two correlated variables to eliminate the effect.⁴ Overall, this analysis is useful to the planner in that it allows him to determine the collateral influence he will have on other system variables through his actions on the target variable.⁵ The planner may then consider whether the effect is in line with objectives and either accept or reject taking action against the given financial center. (In time series analysis, it is accepted that there will be correlation between variables, especially in a model depicting the relationships between variables and GDP. However, no adjustments to the model will be made solely due to the correlation between variables.)

Signs of the Coefficients. Contributions of the variables to the GDP value are either positive or negative. For this model, the following signs were expected:

Intercept. In all cases, positive. A negative value is theoretically not valid as it represents a GDP value less than zero with no inputs from the other variables. Should an intercept value in the model be less than zero for any country, that intercept will be regarded as statistically insignificant. In all such cases, the regression model was rerun suppressing the intercept value.

Foreign Debt. Generally, positive for high or medium GDP countries and negative for low GDP countries. Because the variable was determined to be the measure of government foreign debt, it was expected that government borrowing would be used to positively influence a country's GDP through economic stimulus. However, at low levels of GDP, foreign borrowing may account for a significant portion of a country's budget and monies would have to be used to pay the interest and principle of the loans. This would leave that country in a worse position.

Banks. Positive. The liquidity position of a central bank is important to the ability of a country to react to changes in the foreign exchange market. Countries with higher liquidity relative to GDP should be in a better position to react to changes in the currency market.

Exports. Positive. Exports of goods and services represent a foreign demand for domestic production. The production within a country contributes to the GDP in all but the most backward of economies.

Imports. Negative. Imports drain currency from a country to pay for goods created outside of the country's economy. The outward flow of currency is thus not available for use in purchasing goods domestically. This will result in a decline in GDP.

Autocorrelation of Error Terms. The Durbin-Watson statistical test was used to determine if autocorrelation among error terms was present.⁶ Autocorrelation causes problems such as incorrect values for the standard errors and coefficients. Unfortunately this problem can often arise when dealing with GDP values because high values in one period tend to be followed by a similar high value in the following period.⁷ While

problems associated with this phenomena are recognized, no adjustments were made to the general form of the model to account for or eliminate them.

Country Analysis

In this section, each of the regression results are separately examined to determine their validity and utility for planners. Only the final form of the models as adjusted for the outcomes of the statistical inference tests are provided. Where common sense explanations exist for irregularities in the data, the results will be tied to events that proved to have effects on the individual economies. Principally, however, the main purpose is to identify those areas that may be particularly sensitive in influencing the GDP of a country.

For the initial regressions the R^2 values indicated that the Goodness of Fit for the model was acceptable throughout the range of countries analyzed. The minimum value achieved was for South Africa (0.8116) and the maximum for Zimbabwe (0.9981), with the majority above 0.90. All models proved to be statistically significant at the 0.01 level overall as represented by the F statistics. For purposes of this analysis, if the coefficients of the independent variables were significant at the 0.05 level in over 50% of the regressions they could be considered suitable for further study. Detailed analysis by country is required to determine if adjustments to the variables are appropriate. In general, Exports and Imports appear to be the areas deserving of further study.

Argentina

Foreign Debt	Banks	Exports	Imports
not in final model	no	yes	yes

Argentina was a mid GDP country in the Arnold study. Incomplete data was available to cover the full thirty year analysis period. There were also significant gaps in

the reporting of Foreign Debt data. Once the regression was run eliminating Foreign Debt as a variable the results revealed a negative coefficient for the intercept. A third regression was run utilizing the technique of suppressing the intercept to zero. The results revealed a valid model with an R^2 of 0.8797, overall significance of the model, and statistically significant coefficients for both Exports and Imports. The Durbin-Watson test indicated that autocorrelation was not present. Exports and Imports were highly correlated (-0.845835). The signs of the coefficients were as expected.

The modified version of the model is adequate for further use by planners. The most likely area for concentration of further study is trade.

Brazil

Foreign Debt	Banks	Exports	Imports
not in final model	no	yes	yes

Brazil was a high GDP country in the Arnold study. Similar to Argentina, Foreign Debt values were missing from much of the analysis period and the thirty year period had to be reduced because of other missing data. The regression run without Foreign Debt provided a high R^2 (0.9901) as well as proving the model as significant overall. Again, the only statistically significant coefficients were related to Exports and Imports, and an almost perfect negative correlation existed between these two variables (-0.99378). The test for autocorrelation proved inconclusive. Interestingly, the sign of the coefficients for Banks was negative.

The structure of the Brazilian economy has changed significantly over the past thirty years. Periods of extremely high inflation and government uncertainty could have

led to an ineffective central bank for much of the period under consideration. The extreme inflation would have a detrimental effect on the economy and thus on GDP.

The high correlation between Exports and Imports led to the conclusion that trade was a particularly vulnerable area and requires further study. This model may be useful for planners.

Colombia

Foreign Debt	Banks	Exports	Imports
no	yes	yes	yes

Colombia was a low GDP country in the Arnold study. The data was sufficient to allow a full regression analysis incorporating all the variables. The resulting R^2 value was high (0.9964) and the model was statistically significant overall. All coefficients except for Foreign Debt proved to be significant. A high correlation existed between both Foreign Debt and Exports (0.9712), and Foreign Debt and Imports (-0.9664). Similar to the two previous cases, Exports and Imports are highly correlated (-0.9794). The Durbin-Watson test ruled out autocorrelation and the examination of the residuals revealed no signs of heteroscedasticity. The coefficient for Banks was negative and in agreement with the contention of such an outcome for low GDP countries. However, the t-test proved this coefficient to be statistically insignificant.

Adjustments can be made to the model such that the Foreign Debt variable is excluded, but the utility may be questionable. In its current form the model is suitable for use by planners, who should focus on Banks, Imports, and Exports.

India

Foreign Debt	Banks	Exports	Imports
not in final model	no	no	yes

India was a high GDP country in the Arnold study. The model was adjusted to account for the lack of credible Foreign Debt data and a reduction in the number of observations available. Goodness of Fit is high at 0.9697 and the regression was significant overall. The only independent variable that tested as significant was Imports. However, the correlation between Exports and Imports was high (-0.9754). Examination of the residuals for Banks revealed a pattern showing the variance to be increasing both positively and negatively as the residual values increased. The model also proved to have positive autocorrelation.

The results still showed that trade was a likely area for further study. The values of the coefficients for Banks and Exports were quite small. GDP appeared to be particularly sensitive to changes in Imports. The general conclusion is that this model must be refined prior to being used as a planning tool.

Iran

Foreign Debt	Banks	Exports	Imports
no	no	no	no

Iran was a mid GDP country in the Arnold study. The model demonstrated a high R^2 (0.9154) and tested to be overall statistically significant. The remainder of the statistical inference testing indicated that the general form of the model was insufficient to explain the relationship between the independent variables and GDP. None of the coefficients were statistically significant and the model proved to be positively autocorrelated.

This model may be mis-specified. While the variables may be appropriate the relationship among them and with GDP may be other than linear. Further analysis of the

model and the variables is required. In the present form this model is not suitable for use by planners.

Japan

Foreign Debt	Banks	Exports	Imports
yes	yes	yes	yes

Japan was a high GDP country in the Arnold study. The initial regression resulted in an intercept value less than zero, and was therefore reperformed with the intercept suppressed. R^2 for this model was 0.9506. The F test proved the model to be significant, and all coefficients tested to be significant as well. Examination of the residuals revealed a slight cyclic tendency in the residual for Exports, but it was decided not to adjust the variable in this case. Testing for autocorrelation proved inconclusive.

The most interesting facet of this model was that the signs for both Foreign Debt and Imports are opposite to what was expected. No explanation can be offered for the sign related to Foreign Debt nor for the high value of the coefficient. Japan imports most of its raw materials used in production and then adds value to the imports to sell them abroad (e.g., steel used in automobiles). The high proportion of imports used in the production process and their contribution to exports can be directly related. Thus, it was concluded that Imports had a positive effect on GDP for Japan. Exports and Imports have a high negative correlation (-0.9822).

Further in-depth analysis, particularly in the areas of trade and foreign debt, would be useful. The structure of the Japanese economy has also changed considerably over the past thirty years. Possibly a more detailed study covering a shorter time period, but with

more frequent measurement of the variables is warranted. The planner should be interested in this model for the relationships displayed among the variables.

Korea

Foreign Debt	Banks	Exports	Imports
no	yes	yes	no

Korea was the substitute for China and was a mid GDP country in the Arnold study. The regression for Korea proved to be statistically significant overall and had a high R^2 (0.9655). No adjustment had to be made for missing or incomplete data. Only the coefficients for Banks and Imports tested to be statistically significant. Banks and Exports were also positively correlated (0.9219). The residual plots in general were homoscedastic, but there were a few outlying data points related to Banks. The Durbin-Watson test for autocorrelation proved inconclusive.

Adjustments to this model might include the suppression of the intercept value to determine if other variables would become significant. Additionally, the small Import coefficient and insignificant value of the t-test were unexpected. Such further refinements to the model could increase its utility. The model did indicate that areas of interest for planners were the Central Bank and Export aspects of the Korean economy.

Libya

Foreign Debt	Banks	Exports	Imports
not in final model	yes	no	no

Libya was a substitute for Taiwan and was a mid GDP country in the Arnold study. The sample size for this model was only 23 observations and no Foreign Debt data was available. No other adjustments were made. An R^2 value of only 0.8908 was achieved. Only the coefficient for Banks proved statistically significant although the

model was significant overall. The residual plot for Banks tended to high values in the middle regions of the residual ranges. Exports and Imports were highly correlated (-0.9454). The Durbin-Watson statistic was inconclusive.

The relationship among the variables may be mis-specified or the model may not be linear in nature. Intuitively a significant correlation for both Exports and Imports was expected. The model can be considered of questionable utility in its present form and considerable follow-on study of the Libyan economic structure is required.

Mexico

Foreign Debt	Banks	Exports	Imports
not in final model	no	no	yes

Mexico was a mid GDP country in the Arnold study. Foreign Debt data is not available for much of the analysis period. The regression performed with the remaining variables provided positive results. R^2 was high at 0.9912, the model was significant overall, and the coefficients of all independent variables were statistically significant except Banks. The qualifier on this model was that positive autocorrelation present. Banks and Imports were negatively correlated (-0.8160).

The magnitude of the coefficients proved interesting. Exports presented a very small coefficient while Imports were relatively high. These values may reflect the inherent weakness in the Mexican currency over the past several years. Despite the presence of positive autocorrelation, this model is a useful tool for planners, who should concentrate on trade categories and banking as likely areas to influence.

Nigeria

Foreign Debt	Banks	Exports	Imports
no	no	no	yes

Nigeria was a low GDP country in the Arnold study. Overall, the model provided a Goodness of Fit statistic of 0.9773, only one significant coefficient (Imports), and was statistically significant overall. Exports and Imports were highly correlated similar to most of the other country results (-0.9739) and the Durbin-Watson test indicated that positive autocorrelation was present.

Three of the four independent variables were not statistically significant. Export and Imports were highly correlated. While the model identifies the importance of imports to the Nigerian economy, the remainder of the factors are not captured adequately. A different specification for the variables may return better results. The utility of this model for the planner is questionable.

Singapore

Foreign Debt	Banks	Exports	Imports
not in final model	yes	no	N/A

Singapore was a low GDP country in the Arnold study. The regression for Singapore differed from the remainder of the models in that the Exports were reported in IMF statistics as net of Imports. Thus the variable Exports actually reflects "trade" in general. Regression results yielded an R^2 of 0.9737 and an overall statistically significant model. Only the Bank t statistic proved to be significant. The correlation among the variables was relatively high between Banks and Exports (0.8038), and the model was autocorrelated with respect to the residuals.

Singapore is one country for which this model may not be valid due to significant structural changes over the period of analysis. Alternately, the relationship among the

independent variables may be more complex than a linear regression can estimate.

Planners should seek an alternative model to describe the GDP influence.

South Africa

Foreign Debt	Banks	Exports	Imports
yes	yes	yes	no

South Africa was a mid GDP country in the Arnold study. The regression provided an R^2 of 0.8116, among the lowest for all of the countries tested. Imports were the only independent variable that proved to be not statistically significant; however, the model overall was significant. As with many of the other countries there was a high degree of negative correlation between Exports and Imports (-0.9686). The Durbin-Watson statistic was indicative of positive autocorrelation. Interestingly, both of the coefficients for Banks and Foreign Debt were negative.

South Africa was subject to many trade sanctions over the period of analysis, and as a result, the differences from anticipated results are not entirely unexpected. Certainly, the economic structure of the country adjusted to the effects of the trade sanctions and the data may indicate a more profound relationship of these effects over time. Lifting of the trade restrictions in recent years may have a significant effect on the model. The changing structure of the market economy of South Africa was not accounted for in the general form of the model. Given the nature of the underlying structural changes, the utility of this model for South Africa to planners is questionable.

United States

Foreign Debt	Banks	Exports	Imports
yes	no	yes	yes

The United States was a high GDP country in the Arnold study. The initial regression provided results that were entirely unexpected. Most notable in the testing procedures was a cyclical pattern in the plots of the residuals for both Exports and Imports. The adjusted regression used squared values for Exports and Imports to address the heteroscedastic nature of the residuals. Adjusted regression results provided an R^2 value of 0.9497. Overall, the model was statistically significant. Positive autocorrelation was found. The Bank coefficient was not statistically significant. High correlation was evident among all the independent variables.

A plausible explanation for the t-test value obtained for Banks lies in the nature of the variable. The US dollar is generally accepted as the global currency. Although the liquidity position of the Federal Reserve is set to support the dollar, virtually all other large economies depend on a relatively stable dollar for economic trade and general prosperity. The global currency exchange mechanism may influence the stability of the dollar more than the liquidity position of the Federal Reserve.

Both the coefficients for Export and Imports were extremely small. Considering the specification of the variables as squared values indicated that their true sensitivities were indeed quite high. Interestingly, both signs of the coefficients are opposite to what would normally be expected. No positive conclusion can be offered for these results.

Statistically, the model indicated that trade and foreign debt were significant aspects of GDP formation. Planners should find this information useful for conducting a more in-depth analysis.

Zimbabwe

Foreign Debt	Banks	Exports	Imports
yes	yes	yes	yes

Zimbabwe, the final country in the study, was identified as low GDP in the Arnold study. The presence of high positive correlation between Exports and Imports was indicated by testing. Overall, the model proved to be statistically significant with an inconclusive test for autocorrelation and an R^2 of 0.9981. All coefficients tested to be statistically significant, although the signs for both Exports and Imports are opposite the expected results. Also contrary to expectations, the coefficient for Foreign Debt is positive.

The absolute values of the coefficients for Exports and Imports were very small. While the coefficients are significant, overall trade is not considered an area of prime interest in this model. Both Banks and Foreign Debt had similar coefficient magnitudes; these two are potential areas that should be further studied by planners.

Notes

¹ Regression analysis accomplished using the Analysis Toolpack functions of *Microsoft Excel* Version 5.0, Windows (Redmond: Microsoft Corp, 1993-94)

² Jacob Cohen and Patricia Cohen. *Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences*. (Hillsdale: Lawrence Erlbaum Associates, 1983)

³ Donald R. Plane and Edward B. Opperman. *Business and Economic Statistics*. (Plano: Busines Publications, Inc., 1981): 336.

⁴ *Ibid.*, 382.

⁵ Specifically, the correlation value will vary from -1 to 1. A correlation approaching a value of -1 indicates an inverse relationship between variables. A correlation approaching a value of 1 indicates a direct relationship such that an increase in the value of the variable will be accompanied by an increase in the correlated variable's value. Values between -.5 and .5 are generally considered not to be significant.

⁶ Gopal K. Kanji. *100 Statistical Tests* (Newbury Park: SAGE Publications, 1993): 145. The computed Durbin-Watson statistic is compared to bounded critical values. If the computed value is less than the lower bound then positive autocorrelation is present. When the computed value falls between the two bounds, the test is inconclusive. When the computed value is greater than the upper bound, positive autocorrelation is ruled out.

⁷ Plane and Opperman, 382.

Table A-1. Regression Data for Argentina

REGRESSION ANALYSIS																			
Argentina																			
Currency	U	BANKS	C	FORDEBT	C	EXPORT	C	IMPORT	C	GDP	SDR RATE	\$US/SDR Rate	YEAR	BANKS	FORDEBT	EXPORT	IMPORT	Values Expressed in SDR	
YEAR																			
1964		1.53E+08								3.00E-01	1.509E-11	1	1964	1.53E+08	0.00E+00	0.00E+00	0.00E+00		1.99E+10
1965		2.36E+08								4.00E-01	1.885E-11	1	1965	2.36E+08	0.00E+00	0.00E+00	0.00E+00		2.12E+10
1966		2.16E+08								5.00E-01	2.473E-11	1	1966	2.16E+08	0.00E+00	0.00E+00	0.00E+00		2.02E+10
1967		7.27E+08				1.00E-01				6.00E-01	3.5E-11	1	1967	7.27E+08	0.00E+00	2.86E+09	0.00E+00		1.71E+10
1968		7.60E+08				1.00E-01		-1.00E-01		7.00E-01	3.5E-11	1	1968	7.60E+08	0.00E+00	2.86E+09	-2.86E+09		2.00E+10
1969		5.38E+08				1.00E-01		-1.00E-01		8.00E-01	3.5E-11	1	1969	5.38E+08	0.00E+00	2.86E+09	-2.86E+09		2.29E+10
1970		6.73E+08				1.00E-01		-1.00E-01		9.00E-01	4E-11	1	1970	6.73E+08	0.00E+00	2.50E+09	-2.50E+09		2.25E+10
1971		2.89E+08				1.00E-01		-1.00E-01		1.30E+00	5.429E-11	1.003	1971	2.88E+08	0.00E+00	1.84E+09	-1.84E+09		2.39E+10
1972		4.65E+08				2.00E-01		-2.00E-01		2.10E+00	5.429E-11	1.0857	1972	4.28E+08	0.00E+00	3.68E+09	-3.68E+09		3.87E+10
1973		1.32E+09				4.00E-01		-3.00E-01		3.50E+00	6.032E-11	1.1921	1973	1.11E+09	0.00E+00	6.63E+09	-4.97E+09		5.80E+10
1974		1.31E+09				5.00E-01		-4.00E-01		4.90E+00	6.122E-11	1.2026	1974	1.09E+09	0.00E+00	8.17E+09	-6.53E+09		8.00E+10
1975		4.57E+08				1.10E+00		-1.20E+00		1.43E+01	7.1276E-10	1.2142	1975	3.76E+08	4.21E+08	1.54E+09	-1.68E+09		2.01E+10
1976		1.61E+09				2.00E+00		-6.10E+00		7.59E+01	3.1892E-09	1.1545	1976	1.40E+09	6.27E+08	2.95E+09	-1.91E+09		2.38E+10
1977		3.33E+09				4.70E+00		-2.08E+01		2.09E+02	7.2579E-09	1.1675	1977	2.85E+09	6.48E+08	3.76E+09	-2.87E+09		2.88E+10
1978		5.15E+09				1.25E+01		-4.05E+01		5.23E+02	1.307E-08	1.252	1978	4.11E+09	9.56E+08	4.67E+09	-3.10E+09		4.00E+10
1979		9.57E+09				2.51E+01		-1.22E+02		1.43E+03	2.132E-08	1.292	1979	7.41E+09	1.18E+09	5.91E+09	-5.72E+09		6.68E+10
1980		6.90E+09				3.55E+01		-2.49E+02		3.84E+03	2.541E-08	1.3015	1980	5.30E+09	1.40E+09	7.63E+09	-9.80E+09		1.51E+11
1981		3.45E+09				3.00E+02		-5.51E+02		7.47E+03	8.436E-08	1.1792	1981	2.93E+09	3.56E+09	6.13E+09	-6.53E+09		8.86E+10
1982		2.69E+09				2.00E+03		-1.43E+03		2.19E+04	5.3557E-07	1.104	1982	2.44E+09	3.74E+09	3.71E+09	-2.66E+09		4.08E+10
1983		2.59E+09				1.33E+04		-6.39E+03		1.10E+05	2.4353E-06	1.069	1983	2.43E+09	5.46E+09	4.11E+09	-2.62E+09		4.50E+10
1984		2.66E+09				1.45E+05		-3.76E+04		7.91E+05	0.00001752	1.025	1984	2.60E+09	8.30E+09	3.43E+09	-2.15E+09		4.51E+10
1985		4.69E+09				6.23E+05		-3.33E+05		5.31E+06	0.00008793	1.0153	1985	4.62E+09	0.00E+00	7.09E+09	-3.79E+09		6.03E+10
1986		4.14E+09				2.25E+09		-6.31E+05		9.98E+06	0.00015375	1.1732	1986	3.53E+09	1.46E+13	5.30E+09	-4.10E+09		6.49E+10
1987		3.04E+09				8.49E+09		-1.77E+06		2.33E+07	0.0000532	1.2931	1987	2.35E+09	1.60E+13	3.45E+09	-3.32E+09		4.39E+10
1988		4.78E+09				1.39E+10		-6.90E+06		1.11E+08	0.0017992	1.3439	1988	3.56E+09	7.71E+12	5.88E+09	-3.83E+09		6.17E+10
1989		2.88E+09				3.39E+11		-4.24E+08		3.24E+09	0.23589	1.2818	1989	2.25E+09	1.44E+12	1.80E+09	-9.03E+08		1.38E+10
1990		6.01E+09				7.14E+09		-3.19E+09		6.90E+10	0.79456	1.3568	1990	4.43E+09	0.00E+00	8.99E+09	-4.02E+09		8.68E+10
1991		7.44E+09				1.39E+10		-1.10E+10		1.81E+11	1.42828	1.3682	1991	5.43E+09	0.00E+00	9.72E+09	-7.70E+09		1.27E+11
1992		1.14E+10				1.50E+10		-1.84E+10		2.27E+11	1.36194	1.4084	1992	8.12E+09	0.00E+00	1.10E+10	-1.35E+10		1.66E+11
1993		1.58E+10									1.3715	1.3963	1993	1.13E+10	0.00E+00	0.00E+00	0.00E+00		0.00E+00

Table A-3. Regression Data for Colombia

REGRESSION ANALYSIS									
COUNTRY	Colombia								
GDP 1993:									
Currency	U								
YEAR	BANK	C	FORDEBT	EXPORT	C	IMPORT	C	GDP	SDR RATE
1964	1.04E+08	2.96E+09	6.38E+09	-7.17E+09				5.38E+10	9
1965	9.60E+07	3.07E+09	6.94E+09	-6.32E+09				6.08E+10	13.5
1966	7.70E+07	3.50E+09	8.92E+09	-1.11E+10				7.36E+10	13.5
1967	8.30E+07	5.03E+09	9.95E+09	-9.52E+09				8.31E+10	15.76
1968	1.73E+08	6.25E+09	1.25E+10	-1.38E+10				9.64E+10	16.88
1969	2.21E+08	9.28E+09	1.47E+10	-1.59E+10				1.11E+11	17.85
1970	2.06E+08	1.23E+10	1.76E+10	-1.93E+10				1.33E+11	19.09
1971	2.02E+08	1.65E+10	1.87E+10	-2.50E+10				1.56E+11	22.7
1972	3.25E+08	2.11E+10	2.51E+10	-2.43E+10				1.90E+11	24.74
1973	5.32E+08	2.62E+10	3.63E+10	-3.08E+10				2.43E+11	29.91
1974	4.49E+08	2.70E+10	4.70E+10	-5.00E+10				3.22E+11	35.05
1975	5.13E+08	3.50E+10	6.40E+10	-5.70E+10				4.05E+11	38.58
1976	1.16E+09	4.00E+10	9.10E+10	-7.40E+10				5.32E+11	42.2
1977	1.82E+09	4.60E+10	1.21E+11	-9.50E+10				7.16E+11	46.11
1978	2.50E+09	5.00E+10	1.51E+11	-1.26E+11				9.09E+11	53.41
1979	4.06E+09	7.70E+10	1.81E+11	-1.60E+11				1.19E+12	57.96
1980	5.36E+09	1.06E+11	2.56E+11	-2.46E+11				1.58E+12	64.94
1981	5.51E+09	1.30E+11	2.35E+11	-3.06E+11				1.98E+12	68.76
1982	4.79E+09	1.63E+11	2.73E+11	-3.79E+11				2.50E+12	77.54
1983	2.93E+09	0.00E+00	3.19E+11	-4.04E+11				3.05E+12	92.94
1984	1.79E+09	0.00E+00	4.58E+11	-4.81E+11				3.86E+12	111.64
1985	2.19E+09	0.00E+00	6.86E+11	-6.22E+11				4.97E+12	189.15
1986	3.39E+09	0.00E+00	1.28E+12	-8.14E+11				6.79E+12	267.88
1987	3.38E+09	0.00E+00	1.50E+12	-1.14E+12				8.82E+12	374.1
1988	3.72E+09	0.00E+00	1.91E+12	-1.63E+12				1.17E+13	451.97
1989	3.72E+09	0.00E+00	2.72E+12	-2.09E+12				1.51E+13	570.24
1990	4.46E+09	0.00E+00	4.16E+12	-3.00E+12				2.02E+13	809.11
1991	6.35E+09	0.00E+00	5.53E+12	-3.58E+12				2.62E+13	1011.11
1992	7.56E+09	0.00E+00	6.39E+12	-5.30E+12				3.31E+13	1116.18
1993	7.552E+09								1260.01

Values Expressed in SDR

Table A-4. Regression Data for India

REGRESSION ANALYSIS																			
COUNTRY India																			
GDP 1991	1.67E+11	SDR value																	
Currency	US	C	FORDEBT	EXPORT	IMPORT	C	GDP	SDR RATE	\$US/SDR Rate	YEAR	BANKS	FORDEBT	EXPORT	IMPORT	Values Expressed in SDR				
YEAR	BANKS	C	FORDEBT	EXPORT	IMPORT	C	GDP	SDR RATE	\$US/SDR Rate	YEAR	BANKS	FORDEBT	EXPORT	IMPORT					
1964	4.97E+08	-	1.02E+10	-1.53E+10	-	2.48E+11	4.795	1	1964	4.97E+08	0.00E+00	2.13E+09	-3.19E+09	5.17E+10					
1965	5.99E+08	-	9.00E+09	-1.46E+10	-	2.62E+11	4.775	1	1965	5.99E+08	0.00E+00	1.88E+09	-3.06E+09	5.48E+10					
1966	6.06E+08	-	1.30E+10	-2.12E+10	-	2.96E+11	7.576	1	1966	6.06E+08	0.00E+00	1.72E+09	-2.80E+09	3.90E+10					
1967	6.61E+08	-	1.51E+10	-2.20E+10	-	3.46E+11	7.547	1	1967	6.61E+08	0.00E+00	2.00E+09	-2.92E+09	4.59E+10					
1968	6.78E+08	-	1.60E+10	-1.90E+10	-	3.67E+11	7.628	1	1968	6.78E+08	0.00E+00	2.10E+09	-2.49E+09	4.81E+10					
1969	9.24E+08	-	1.63E+10	-1.75E+10	-	4.04E+11	7.559	1	1969	9.24E+08	0.00E+00	2.16E+09	-2.32E+09	5.34E+10					
1970	1.00E+09	-	1.64E+10	-1.82E+10	-	4.32E+11	7.576	1	1970	1.00E+09	0.00E+00	2.16E+09	-2.40E+09	5.70E+10					
1971	1.19E+09	-	1.79E+10	-2.18E+10	-	4.62E+11	7.903	1.003	1971	1.19E+09	0.00E+00	2.26E+09	-2.76E+09	5.85E+10					
1972	1.14E+09	-	2.15E+10	-2.05E+10	-	5.10E+11	8.773	1.0857	1972	1.05E+09	0.00E+00	2.45E+09	-2.34E+09	5.81E+10					
1973	1.07E+09	-	2.66E+10	-3.80E+10	-	6.20E+11	9.896	1.1921	1973	8.98E+08	0.00E+00	2.69E+09	-3.84E+09	6.27E+10					
1974	1.26E+09	6.42E+10	3.69E+10	-4.78E+10	-	7.32E+11	9.978	1.2026	1974	1.04E+09	6.43E+09	3.70E+09	-4.79E+09	7.34E+10					
1975	1.29E+09	7.60E+10	4.95E+10	-5.66E+10	-	7.88E+11	10.462	1.2142	1975	1.06E+09	7.26E+09	4.73E+09	-5.41E+09	7.53E+10					
1976	3.00E+09	8.60E+10	6.13E+10	-5.61E+10	-	8.49E+11	10.318	1.1545	1976	2.60E+09	8.33E+09	5.94E+09	-5.44E+09	8.23E+10					
1977	5.11E+09	9.00E+10	6.40E+10	-6.52E+10	-	9.61E+11	9.971	1.1675	1977	4.37E+09	9.03E+09	6.42E+09	-6.54E+09	9.63E+10					
1978	6.69E+09	9.40E+10	7.12E+10	-7.42E+10	-	1.04E+12	10.665	1.252	1978	5.35E+09	8.81E+09	6.68E+09	-6.96E+09	9.77E+10					
1979	7.72E+09	1.00E+12	8.34E+10	-1.01E+11	-	1.14E+12	10.416	1.292	1979	5.97E+09	9.60E+10	8.01E+09	-9.69E+09	1.10E+11					
1980	7.23E+09	1.08E+12	9.03E+10	-1.36E+11	-	1.36E+12	10.114	1.3015	1980	5.55E+09	1.07E+11	8.93E+09	-1.34E+11	1.34E+11					
1981	4.94E+09	1.18E+12	1.03E+11	-1.48E+11	-	1.60E+12	10.591	1.1792	1981	4.19E+09	1.11E+11	9.69E+09	-1.40E+10	1.51E+11					
1982	4.55E+09	1.32E+12	1.16E+11	-1.57E+11	-	1.78E+12	10.627	1.104	1982	4.12E+09	1.24E+11	1.09E+10	-1.48E+10	1.68E+11					
1983	5.15E+09	1.45E+12	1.31E+11	-1.77E+11	-	2.08E+12	10.986	1.069	1983	4.82E+09	1.32E+11	1.20E+10	-1.61E+10	1.89E+11					
1984	6.03E+09	1.61E+12	1.59E+11	-1.95E+11	-	2.31E+12	12.205	1.025	1984	5.88E+09	1.32E+11	1.30E+10	-1.60E+10	1.90E+11					
1985	6.62E+09	1.81E+12	1.50E+11	-2.18E+11	-	2.62E+12	13.363	1.0153	1985	6.52E+09	1.35E+11	1.12E+10	-1.63E+10	1.96E+11					
1986	6.61E+09	2.03E+12	1.65E+11	-2.24E+11	-	2.93E+12	16.051	1.1732	1986	5.63E+09	1.26E+11	1.03E+10	-1.39E+10	1.83E+11					
1987	6.67E+09	2.32E+12	2.03E+11	-2.53E+11	-	3.33E+12	18.268	1.2931	1987	5.16E+09	1.27E+11	1.11E+10	-1.38E+10	1.82E+11					
1988	5.08E+09	2.58E+12	2.59E+11	-3.20E+11	-	3.96E+12	20.117	1.3439	1988	3.78E+09	1.28E+11	1.29E+10	-1.59E+10	1.97E+11					
1989	4.02E+09	2.83E+12	3.46E+11	-4.03E+11	-	4.57E+12	22.387	1.2818	1989	3.14E+09	1.26E+11	1.55E+10	-1.80E+10	2.04E+11					
1990	5.19E+09	3.15E+12	4.06E+11	-4.87E+11	-	5.32E+12	25.712	1.3568	1990	3.82E+09	1.23E+11	1.58E+10	-1.89E+10	2.07E+11					
1991	6.80E+09	3.55E+12	5.68E+11	-5.69E+11	-	6.16E+12	36.953	1.3682	1991	4.97E+09	9.61E+10	1.54E+10	-1.54E+10	1.67E+11					

Table A-5. Regression Data for Iran

REGRESSION ANALYSIS																			
COUNTRY: Iran																			
GDP 1993:																			
Currency	U	BANKS	C	FORDEBT	EXPORT	IMPORT	C	GDP	SDR RATE	\$US/SDR Rate	YEAR	BANKS	FORDEBT	EXPORT	IMPORT	GDP	Values Expressed in SDR		
YEAR																			
1964		1.91E+08			8.40E+07	-4.20E+07		4.36E+08	75.75	1	1964	1.91E+08	0.00E+00	1.11E+06	-5.54E+05	5.76E+06			
1965		2.51E+08			7.60E+07	-7.00E+07		4.78E+08	75.75	1	1965	2.51E+08	0.00E+00	1.00E+06	-9.24E+05	6.31E+06			
1966		2.68E+08			8.40E+07	-8.10E+07		5.23E+08	75.75	1	1966	2.68E+08	0.00E+00	1.11E+06	-1.07E+06	6.90E+06			
1967		3.24E+08			9.90E+07	-1.01E+08		5.77E+08	75.75	1	1967	3.24E+08	0.00E+00	1.31E+06	-1.33E+06	7.62E+06			
1968		2.91E+08			1.14E+08	-1.20E+08		6.24E+08	75.09	1	1968	2.91E+08	0.00E+00	1.52E+06	-1.60E+06	8.31E+06			
1969		3.10E+08			1.33E+08	-1.40E+08		8.04E+08	76.38	1	1969	3.10E+08	2.23E+05	1.74E+06	-1.83E+06	1.05E+07			
1970		2.08E+08			1.54E+08	-1.58E+08		7.71E+08	76.38	1	1970	2.08E+08	2.49E+05	2.02E+06	-2.07E+06	1.01E+07			
1971		6.21E+08			2.41E+08	-1.99E+08		9.69E+08	82.93	1.003	1971	6.19E+08	1.81E+05	2.91E+06	-2.40E+06	1.17E+07			
1972		9.60E+08			2.99E+08	-2.51E+08		1.21E+09	82.93	1.0857	1972	8.84E+08	1.33E+05	3.61E+06	-3.03E+06	1.46E+07			
1973		1.24E+09			6.42E+08	-3.45E+08		1.76E+09	81.58	1.1921	1973	1.04E+09	-3.68E+04	7.87E+06	-4.23E+06	2.16E+07			
1974		8.38E+09			1.74E+08	1.48E+09		3.09E+09	82.8	1.2026	1974	6.97E+09	-2.10E+06	1.79E+07	-8.16E+06	3.73E+07			
1975		8.90E+09			1.36E+08	1.44E+09		3.51E+09	81.1	1.2142	1975	7.33E+09	-1.68E+06	1.78E+07	-1.39E+07	4.33E+07			
1976		8.83E+09			9.30E+07	1.79E+09		4.70E+09	82.05	1.1545	1976	7.65E+09	-1.13E+06	2.18E+07	-1.58E+07	5.72E+07			
1977		1.23E+10			6.90E+07	1.75E+09		5.95E+09	85.61	1.1675	1977	1.05E+10	-8.06E+05	2.05E+07	-1.74E+07	6.95E+07			
1978		1.22E+10			5.60E+07	1.19E+09		5.18E+09	91.81	1.252	1978	9.71E+09	-6.10E+05	1.30E+07	-1.20E+07	5.64E+07			
1979		1.54E+10			3.50E+07	1.76E+09		5.97E+09	92.84	1.292	1979	1.19E+10	-3.77E+05	1.90E+07	-9.94E+06	6.43E+07			
1980		1.04E+10			3.70E+07	8.83E+08		6.63E+09	92.3	1.3015	1980	8.00E+09	-4.01E+05	9.57E+06	-1.18E+07	7.19E+07			
1981		1.78E+09			4.50E+07	9.45E+08		8.01E+09	92.3	1.1792	1981	1.51E+09	-4.88E+05	1.02E+07	-1.37E+07	8.68E+07			
1982		5.87E+09			3.80E+07	1.73E+09		1.05E+10	92.3	1.104	1982	5.32E+09	-4.12E+05	1.87E+07	-1.36E+07	1.14E+08			
1983		1.59E+08			3.60E+07	1.88E+09		1.34E+10	92.3	1.089	1983	1.49E+08	-3.90E+05	2.03E+07	-2.01E+07	1.45E+08			
1984		1.49E+08			3.00E+07	1.57E+09		1.48E+10	92.3	1.025	1984	1.45E+08	-3.25E+05	1.70E+07	-1.74E+07	1.60E+08			
1985		1.67E+08			3.10E+07	1.25E+09		1.58E+10	92.3	1.0153	1985	1.64E+08	-3.36E+05	1.36E+07	-1.37E+07	1.71E+08			
1986		1.86E+08			2.20E+07	5.53E+08		1.62E+10	92.3	1.1732	1986	1.59E+08	-2.38E+05	5.99E+06	-1.01E+07	1.76E+08			
1987		2.16E+08			1.10E+07	8.37E+08		1.99E+10	92.3	1.2931	1987	1.67E+08	-1.19E+05	9.07E+06	-1.03E+07	2.16E+08			
1988		2.05E+08			7.00E+06	1.51E+09		2.23E+10	92.3	1.3439	1988	1.53E+08	-7.58E+04	1.64E+07	-1.90E+07	2.42E+08			
1989		2.00E+08			4.00E+06	2.77E+09		2.78E+10	92.3	1.2818	1989	1.56E+08	-4.33E+04	3.00E+07	-3.89E+07	3.01E+08			
1990		2.16E+08			5.00E+06	5.40E+09		3.66E+10	92.3	1.3568	1990	1.59E+08	-5.42E+04	5.85E+07	-7.36E+07	3.97E+08			
1991		2.17E+08			0.00E+00	7.44E+09		5.01E+10	92.3	1.3682	1991	1.59E+08	0.00E+00	8.06E+07	-1.06E+08	5.43E+08			
1992		2.09E+08			0.00E+00	9.65E+09		6.78E+10	92.3	1.4084	1992	1.48E+08	0.00E+00	1.04E+08	-1.24E+08	7.35E+08			
1993		0.00E+00							2415.49	1.3963	1993	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00			

Table A-6. Regression Data for Japan

REGRESSION ANALYSIS																
Japan																
														</		

Table A-7. Regression Data for Korea

REGRESSION ANALYSIS																			
COUNTRY/Korea																			
GDP 1993:	2.39E+11	SDR value																	
Currency	US	C	FORDEBT	EXPORT	IMPORT	GDP	SDR RATE	\$US/SDR Rate	YEAR	BANKS	FORDEBT	EXPORT	IMPORT	Values Expressed in SDR					
YEAR	BANKS	C	EXPORT	IMPORT	C	GDP													GDP
1964	1.36E+08	-	4.21E+10	-9.64E+10		7.11E+11	255.77	1	1964	1.36E+08	0.00E+00	1.65E+08	-3.77E+08						2.78E+09
1965	1.46E+08	-	6.86E+10	-1.28E+11		7.98E+11	271.78	1	1965	1.46E+08	0.00E+00	2.52E+08	-4.70E+08						2.94E+09
1966	2.45E+08	-	1.07E+11	-2.08E+11		1.02E+12	271.18	1	1966	2.45E+08	0.00E+00	3.95E+08	-7.67E+08						3.78E+09
1967	3.56E+08	-	1.45E+11	-2.79E+11		1.26E+12	274.6	1	1967	3.56E+08	0.00E+00	5.28E+08	-1.02E+09						4.58E+09
1968	3.91E+08	-	2.09E+11	-4.17E+11		1.63E+12	281.5	1	1968	3.91E+08	0.00E+00	7.42E+08	-1.48E+09						5.79E+09
1969	5.53E+08	-	2.88E+11	-5.42E+11		2.13E+12	304.45	1	1969	5.53E+08	0.00E+00	9.46E+08	-1.78E+09						7.00E+09
1970	6.10E+08	1.98E+11	3.82E+11	-6.43E+11		2.72E+12	316.65	1	1970	6.10E+08	6.25E+08	1.21E+09	-2.03E+09						8.60E+09
1971	4.37E+08	3.17E+11	5.17E+11	-8.67E+11		3.38E+12	405.3	1.003	1971	4.36E+08	7.82E+08	1.28E+09	-2.14E+09						8.34E+09
1972	5.27E+08	4.56E+11	8.19E+11	-1.02E+12		4.17E+12	433.09	1.0857	1972	4.85E+08	1.05E+09	1.89E+09	-2.34E+09						9.63E+09
1973	8.89E+08	5.80E+11	1.58E+12	-1.74E+12		5.42E+12	479.52	1.1921	1973	7.46E+08	1.21E+09	3.29E+09	-3.63E+09						1.13E+10
1974	2.82E+08	8.31E+11	2.07E+12	-2.92E+12		7.57E+12	592.59	1.2026	1974	2.34E+08	1.40E+09	3.49E+09	-4.92E+09						1.28E+10
1975	7.86E+08	1.12E+12	2.86E+12	-3.73E+12		1.02E+13	566.6	1.2142	1975	6.47E+08	1.98E+09	5.04E+09	-6.58E+09						1.81E+10
1976	1.97E+09	1.33E+12	4.45E+12	-4.62E+12		1.40E+13	562.33	1.1545	1976	1.71E+09	2.36E+09	7.91E+09	-8.22E+09						2.49E+10
1977	2.97E+09	1.70E+12	5.71E+12	-5.81E+12		1.81E+13	587.92	1.1675	1977	2.55E+09	2.88E+09	9.71E+09	-9.89E+09						3.07E+10
1978	2.79E+09	2.12E+12	7.23E+12	-8.06E+12		2.43E+13	630.55	1.252	1978	2.23E+09	3.36E+09	1.15E+10	-1.28E+10						3.86E+10
1979	2.99E+09	2.35E+12	8.74E+12	-1.08E+13		3.13E+13	637.59	1.292	1979	2.31E+09	3.68E+09	1.37E+10	-1.70E+10						4.91E+10
1980	2.96E+09	3.82E+12	1.29E+13	-1.58E+13		3.80E+13	841.64	1.3015	1980	2.27E+09	4.54E+09	1.54E+10	-1.87E+10						4.52E+10
1981	2.71E+09	4.50E+12	1.73E+13	-1.97E+13		4.75E+13	815.35	1.1792	1981	2.30E+09	5.51E+09	2.13E+10	-2.42E+10						5.82E+10
1982	2.84E+09	5.32E+12	1.88E+13	-2.02E+13		5.44E+13	826.01	1.104	1982	2.57E+09	6.44E+09	2.27E+10	-2.44E+10						6.59E+10
1983	2.38E+09	5.97E+12	2.27E+13	-2.30E+13		6.38E+13	832.85	1.069	1983	2.22E+09	7.17E+09	2.73E+10	-2.77E+10						7.66E+10
1984	2.79E+09	6.37E+12	2.61E+13	-2.60E+13		7.26E+13	811.03	1.025	1984	2.72E+09	7.86E+09	3.22E+10	-3.21E+10						8.96E+10
1985	2.90E+09	7.33E+12	2.80E+13	-2.69E+13		8.21E+13	977.81	1.0153	1985	2.86E+09	7.50E+09	2.86E+10	-2.75E+10						8.39E+10
1986	3.35E+09	7.82E+12	3.60E+13	-3.03E+13		9.57E+13	1053.66	1.1732	1986	2.86E+09	7.42E+09	3.42E+10	-2.88E+10						9.09E+10
1987	3.62E+09	7.86E+12	4.51E+13	-3.64E+13		1.12E+14	1124	1.2931	1987	2.80E+09	6.99E+09	4.01E+10	-3.23E+10						9.98E+10
1988	1.23E+10	5.97E+12	5.11E+13	-4.06E+13		1.33E+14	920.59	1.3439	1988	9.14E+09	6.48E+09	5.55E+10	-4.41E+10						1.45E+11
1989	1.52E+10	5.11E+12	4.88E+13	-4.48E+13		1.49E+14	893.1	1.2818	1989	1.19E+10	5.72E+09	5.47E+10	-5.01E+10						1.67E+11
1990	1.48E+10	5.56E+12	5.35E+13	-5.44E+13		1.80E+14	1019.19	1.3568	1990	1.09E+10	5.45E+09	5.25E+10	-5.34E+10						1.76E+11
1991	1.37E+10	5.70E+12	4.07E+13	-6.61E+13		2.16E+14	1088.27	1.3682	1991	1.00E+10	5.24E+09	3.74E+10	-6.07E+10						1.98E+11
1992	1.72E+10	0.00E+00	6.94E+13	-7.18E+13		2.40E+14	1094.05	1.4084	1992	1.22E+10	0.00E+00	6.40E+10	-6.63E+10						2.22E+11
1993	2.07E+10	0.00E+00	7.80E+13	-7.69E+13		2.66E+14	1109.97	1.3963	1993	1.48E+10	0.00E+00	7.03E+10	4.81E+21						2.39E+11

Table A-8. Regression Data for Libya

REGRESSION ANALYSIS											
COUNTRY: Libya											
GDP 1986:	2.03E+09	SDR value									
Currency	US	C	C								
YEAR	BANKS	EXPORT	IMPORT	GDP	SDR RATE	\$US/SDR Rate	YEAR	BANKS	EXPORT	IMPORT	GDP
1964	1.72E+08	2.34E+08	-1.63E+08	4.16E+08	2.8	1	1964	1.72E+08	8.36E+07	-5.82E+07	1.49E+08
1965	2.48E+08	2.99E+08	-1.83E+08	5.60E+08	2.8	1	1965	2.48E+08	1.07E+08	-6.54E+07	2.00E+08
1966	3.39E+08	3.70E+08	-2.23E+08	7.17E+08	2.8	1	1966	3.39E+08	1.32E+08	-7.96E+07	2.56E+08
1967	3.85E+08	4.31E+08	-2.53E+08	8.45E+08	2.8	1	1967	3.85E+08	1.54E+08	-9.04E+07	3.02E+08
1968	5.39E+08	6.80E+08	-3.33E+08	1.19E+09	2.8	1	1968	5.39E+08	2.43E+08	-1.19E+08	4.26E+08
1969	9.18E+08	7.88E+08	-4.19E+08	1.36E+09	2.8	1	1969	9.18E+08	2.81E+08	-1.50E+08	4.85E+08
1970	1.59E+09	8.70E+08	-4.03E+08	1.43E+09	2.8	1	1970	1.59E+09	3.11E+08	-1.44E+08	5.09E+08
1971	2.67E+09	9.75E+08	-4.36E+08	1.63E+09	2.8	1.003	1971	2.66E+09	3.48E+08	-1.56E+08	5.81E+08
1972	2.93E+09	9.98E+08	-5.52E+08	1.80E+09	2.8	1.0857	1972	2.70E+09	3.56E+08	-1.97E+08	6.42E+08
1973	2.12E+09	1.24E+09	-8.26E+08	2.25E+09	2.8	1.1921	1973	1.78E+09	4.43E+08	-2.95E+08	8.02E+08
1974	3.61E+09	2.49E+09	-1.43E+09	3.88E+09	2.7589	1.2026	1974	3.01E+09	9.03E+08	-5.18E+08	1.41E+09
1975	2.20E+09	2.05E+09	-1.67E+09	3.78E+09	2.8854	1.2142	1975	1.81E+09	7.12E+08	-5.77E+08	1.31E+09
1976	3.21E+09	2.88E+09	-1.67E+09	4.91E+09	2.9073	1.1545	1976	2.78E+09	9.91E+08	-5.75E+08	1.69E+09
1977	4.89E+09	3.43E+09	-1.95E+09	5.76E+09	2.7807	1.1675	1977	4.19E+09	1.23E+09	-7.01E+08	2.07E+09
1978	4.21E+09	2.98E+09	-2.20E+09	5.69E+09	2.5927	1.252	1978	3.36E+09	1.15E+09	-8.48E+08	2.19E+09
1979	6.45E+09	4.80E+09	-2.82E+09	7.85E+09	2.5641	1.292	1979	4.99E+09	1.87E+09	-1.10E+09	3.06E+09
1980	1.32E+10	6.74E+09	-3.40E+09	1.05E+10	2.6484	1.3015	1980	1.02E+10	2.54E+09	-1.28E+09	3.98E+09
1981	9.15E+09	4.87E+09	-4.31E+09	9.34E+09	2.902	1.1792	1981	7.76E+09	1.68E+09	-1.48E+09	3.22E+09
1982	7.20E+09	4.11E+09	-3.92E+09	8.85E+09	3.0621	1.104	1982	6.52E+09	1.34E+09	-1.28E+09	2.89E+09
1983	5.67E+09	0.00E+00	0.00E+00	8.53E+09	3.2263	1.069	1983	5.30E+09	0.00E+00	0.00E+00	2.64E+09
1984	3.79E+09	0.00E+00	0.00E+00	7.57E+09	3.446	1.025	1984	3.70E+09	0.00E+00	0.00E+00	2.20E+09
1985	6.06E+09	0.00E+00	0.00E+00	7.20E+09	3.0751	1.0153	1985	5.96E+09	0.00E+00	0.00E+00	2.34E+09
1986	6.11E+09	0.00E+00	0.00E+00	6.47E+09	3.186	1.1732	1986	5.20E+09	0.00E+00	0.00E+00	2.03E+09

Table A-11. Regression Data for Singapore

REGRESSION ANALYSIS										Note: exports are net; separate import data not available									
Singapore																			
GDP 1993	4.03E+10	SDR value																	
Currency U		C																	
YEAR	BANKS	FORDEBT	EXPORTS (net)	GDP	SDR RATE	\$US/SDR Rate	YEAR	BANKS	FORDEBT	EXPORT (net)	GDP	SDR RATE	\$US/SDR Rate	YEAR	BANKS	FORDEBT	EXPORT (net)	GDP	
1964	4.31E+08	5.07E+08	-3.19E+08	2.72E+09	3.07	1	1964	4.31E+08	1.65E+08	-1.04E+08	8.84E+08			1964	4.31E+08	1.65E+08	-1.04E+08	8.84E+08	
1965	4.30E+08	5.14E+08	-3.56E+08	2.96E+09	3.06	1	1965	4.30E+08	1.68E+08	-1.16E+08	9.66E+08			1965	4.30E+08	1.68E+08	-1.16E+08	9.66E+08	
1966	3.94E+08	7.00E+08	-2.74E+08	3.33E+09	3.08	1	1966	3.94E+08	2.27E+08	-8.90E+07	1.08E+09			1966	3.94E+08	2.27E+08	-8.90E+07	1.08E+09	
1967	4.96E+08	1.02E+09	-3.16E+08	3.75E+09	3.07	1	1967	4.96E+08	3.34E+08	-1.03E+08	1.22E+09			1967	4.96E+08	3.34E+08	-1.03E+08	1.22E+09	
1968	7.12E+08	1.64E+09	-2.84E+08	4.32E+09	3.08	1	1968	7.12E+08	5.31E+08	-9.22E+07	1.40E+09			1968	7.12E+08	5.31E+08	-9.22E+07	1.40E+09	
1969	8.27E+08	1.75E+09	-5.32E+08	5.02E+09	3.09	1	1969	8.27E+08	5.67E+08	-1.72E+08	1.62E+09			1969	8.27E+08	5.67E+08	-1.72E+08	1.62E+09	
1970	1.01E+09	1.99E+09	-1.18E+09	5.81E+09	3.08	1	1970	1.01E+09	6.46E+07	-3.83E+08	1.88E+09			1970	1.01E+09	6.46E+07	-3.83E+08	1.88E+09	
1971	1.45E+09	2.64E+08	-1.48E+09	6.82E+09	3.1486	1.003	1971	1.45E+09	8.38E+07	-4.71E+08	2.17E+09			1971	1.45E+09	8.38E+07	-4.71E+08	2.17E+09	
1972	1.75E+09	4.53E+08	-1.38E+09	8.16E+09	3.0617	1.0857	1972	1.61E+09	1.48E+08	-4.50E+08	2.66E+09			1972	1.61E+09	1.48E+08	-4.50E+08	2.66E+09	
1973	2.29E+09	4.82E+08	-1.04E+09	1.02E+10	2.9991	1.1921	1973	1.92E+09	1.61E+08	-3.47E+08	3.40E+09			1973	1.92E+09	1.61E+08	-3.47E+08	3.40E+09	
1974	2.81E+09	5.24E+08	-2.13E+09	1.25E+10	2.8307	1.2026	1974	2.34E+09	1.85E+08	-7.54E+08	4.43E+09			1974	2.34E+09	1.85E+08	-7.54E+08	4.43E+09	
1975	3.01E+09	5.49E+08	-1.51E+09	1.34E+10	2.9144	1.2142	1975	2.48E+09	1.88E+08	-5.17E+08	4.59E+09			1975	2.48E+09	1.88E+08	-5.17E+08	4.59E+09	
1976	3.36E+09	7.17E+08	-1.20E+09	1.47E+10	2.8529	1.1545	1976	2.91E+09	2.51E+08	-4.20E+08	5.14E+09			1976	2.91E+09	2.51E+08	-4.20E+08	5.14E+09	
1977	3.86E+09	1.01E+09	-4.24E+08	1.60E+10	2.8406	1.1675	1977	3.30E+09	3.55E+08	-1.49E+08	5.65E+09			1977	3.30E+09	3.55E+08	-1.49E+08	5.65E+09	
1978	5.30E+09	1.02E+09	-8.98E+08	1.78E+10	2.8186	1.252	1978	4.24E+09	3.62E+08	-3.19E+08	6.33E+09			1978	4.24E+09	3.62E+08	-3.19E+08	6.33E+09	
1979	5.82E+09	9.75E+08	-1.45E+09	2.05E+10	2.8441	1.292	1979	4.50E+09	3.43E+08	-5.08E+08	7.22E+09			1979	4.50E+09	3.43E+08	-5.08E+08	7.22E+09	
1980	6.57E+09	9.28E+08	-2.22E+09	2.51E+10	2.6701	1.3015	1980	5.05E+09	3.48E+08	-8.30E+08	9.40E+09			1980	5.05E+09	3.48E+08	-8.30E+08	9.40E+09	
1981	7.55E+09	8.90E+08	-1.63E+09	2.93E+10	2.3836	1.1792	1981	6.40E+09	3.73E+08	-6.86E+08	1.23E+10			1981	6.40E+09	3.73E+08	-6.86E+08	1.23E+10	
1982	8.48E+09	8.69E+08	-1.44E+09	3.27E+10	2.3259	1.104	1982	7.68E+09	3.74E+08	-6.20E+08	1.40E+10			1982	7.68E+09	3.74E+08	-6.20E+08	1.40E+10	
1983	9.62E+09	6.73E+08	-6.64E+08	3.67E+10	2.2269	1.069	1983	9.00E+09	3.02E+08	-2.98E+08	1.65E+10			1983	9.00E+09	3.02E+08	-2.98E+08	1.65E+10	
1984	1.04E+10	6.35E+08	-1.11E+09	4.00E+10	2.1349	1.025	1984	1.02E+10	2.97E+08	-5.21E+08	1.88E+10			1984	1.02E+10	2.97E+08	-5.21E+08	1.88E+10	
1985	1.28E+10	5.91E+08	-9.46E+08	3.89E+10	2.3122	1.0153	1985	1.27E+10	2.56E+08	-4.09E+08	1.68E+10			1985	1.27E+10	2.56E+08	-4.09E+08	1.68E+10	
1986	1.29E+10	3.36E+08	1.43E+08	3.87E+10	2.6604	1.1732	1986	1.10E+10	1.26E+08	5.38E+07	1.45E+10			1986	1.10E+10	1.26E+08	5.38E+07	1.45E+10	
1987	1.52E+10	2.91E+08	5.89E+08	4.26E+10	2.8352	1.2931	1987	1.18E+10	1.03E+08	2.08E+08	1.50E+10			1987	1.18E+10	1.03E+08	2.08E+08	1.50E+10	
1988	1.71E+10	1.78E+08	2.53E+09	5.00E+10	2.619	1.3439	1988	1.27E+10	6.80E+07	9.65E+08	1.91E+10			1988	1.27E+10	6.80E+07	9.65E+08	1.91E+10	
1989	2.03E+10	1.30E+08	5.70E+09	5.75E+10	2.4895	1.2818	1989	1.59E+10	5.22E+07	2.29E+09	2.31E+10			1989	1.59E+10	5.22E+07	2.29E+09	2.31E+10	
1990	2.77E+10	6.10E+07	4.08E+09	6.62E+10	2.4818	1.3568	1990	2.05E+10	2.46E+07	1.64E+09	2.67E+10			1990	2.05E+10	2.46E+07	1.64E+09	2.67E+10	
1991	3.41E+10	3.80E+07	6.85E+09	7.30E+10	2.3323	1.3882	1991	2.49E+10	1.63E+07	2.94E+09	3.13E+10			1991	2.49E+10	1.63E+07	2.94E+09	3.13E+10	
1992	3.99E+10		5.70E+09	7.91E+10	2.2617	1.4084	1992	2.83E+10	0.00E+00	2.52E+09	3.50E+10			1992	2.83E+10	0.00E+00	2.52E+09	3.50E+10	
1993	4.84E+10		3.19E+09	8.90E+10	2.2087	1.3963	1993	3.46E+10	0.00E+00	1.45E+09	4.03E+10			1993	3.46E+10	0.00E+00	1.45E+09	4.03E+10	

Table A-12. Regression Data for South Africa

REGRESSION ANALYSIS																			
South Africa																			
Currency	U	C	C	C	C	C	C	C	C	SDR/Rand	\$US/SDR Rate	YEAR	BANKS	FORDEBT	EXPORT	IMPORT	Values Expressed in SDR		
YEAR	BANKS	FORDEBT	EXPORT	IMPORT	GDP	GDP	SDR/Rand	\$US/SDR Rate	YEAR	BANKS	FORDEBT	EXPORT	IMPORT	GDP	GDP	GDP			
1964	6.98E+08	1.52E+08	2.03E+09	-1.87E+09	7.03E+09	7.03E+09	1.39313	1	1964	6.98E+08	2.12E+08	2.83E+09	-2.60E+09	9.80E+09	9.80E+09	9.80E+09			
1965	5.96E+08	1.78E+08	2.07E+09	-2.14E+09	7.68E+09	7.68E+09	1.39975	1	1965	5.96E+08	2.49E+08	2.90E+09	-2.99E+09	5.49E+09	5.49E+09	5.49E+09			
1966	8.23E+08	1.35E+08	2.22E+09	-2.01E+09	8.36E+09	8.36E+09	1.39325	1	1966	8.23E+08	1.88E+08	3.09E+09	-2.80E+09	6.00E+09	6.00E+09	6.00E+09			
1967	7.75E+08	1.01E+08	2.40E+09	-2.35E+09	9.36E+09	9.36E+09	1.40175	1	1967	7.75E+08	1.42E+08	3.36E+09	-3.29E+09	6.67E+09	6.67E+09	6.67E+09			
1968	1.45E+09	1.15E+08	2.65E+09	-2.32E+09	1.01E+10	1.01E+10	1.38975	1	1968	1.45E+09	1.60E+08	3.89E+09	-3.23E+09	7.29E+09	7.29E+09	7.29E+09			
1969	1.39E+09	1.28E+08	2.72E+09	-2.64E+09	1.14E+10	1.14E+10	1.39875	1	1969	1.39E+09	1.79E+08	3.80E+09	-3.70E+09	8.15E+09	8.15E+09	8.15E+09			
1970	1.00E+09	2.58E+08	2.75E+09	-3.19E+09	1.25E+10	1.25E+10	1.39425	1	1970	1.00E+09	3.60E+08	3.83E+09	-4.45E+09	8.95E+09	8.95E+09	8.95E+09			
1971	6.99E+08	4.49E+08	3.05E+09	-3.63E+09	1.38E+10	1.38E+10	1.20359	1.003	1971	6.97E+08	5.40E+08	3.88E+09	-4.37E+09	1.14E+10	1.14E+10	1.14E+10			
1972	1.29E+09	5.40E+08	3.99E+09	-3.57E+09	1.55E+10	1.55E+10	1.17647	1.0857	1972	1.18E+09	6.35E+08	4.69E+09	-4.20E+09	1.32E+10	1.32E+10	1.32E+10			
1973	1.29E+09	4.00E+08	4.95E+09	-4.41E+09	1.92E+10	1.92E+10	1.23509	1.1921	1973	1.08E+09	4.94E+08	6.12E+09	-5.44E+09	1.56E+10	1.56E+10	1.56E+10			
1974	1.16E+09	5.38E+08	6.72E+09	-6.84E+09	2.37E+10	2.37E+10	1.18434	1.2026	1974	9.64E+08	6.37E+08	7.95E+09	-8.10E+09	2.00E+10	2.00E+10	2.00E+10			
1975	1.09E+09	9.18E+08	7.48E+09	-8.13E+09	2.66E+10	2.66E+10	0.98235	1.2142	1975	8.99E+08	9.02E+08	7.35E+09	-7.98E+09	2.71E+10	2.71E+10	2.71E+10			
1976	8.56E+08	1.35E+09	8.50E+09	-8.80E+09	3.00E+10	3.00E+10	0.98982	1.1545	1976	7.41E+08	1.33E+09	8.42E+09	-8.71E+09	3.03E+10	3.03E+10	3.03E+10			
1977	7.46E+08	1.38E+09	1.03E+10	-8.49E+09	3.33E+10	3.33E+10	0.94673	1.1675	1977	6.39E+08	1.30E+09	9.79E+09	-8.04E+09	3.51E+10	3.51E+10	3.51E+10			
1978	2.35E+09	1.21E+09	1.27E+10	-9.93E+09	3.82E+10	3.82E+10	0.88272	1.252	1978	1.88E+09	1.07E+09	1.12E+10	-8.77E+09	4.33E+10	4.33E+10	4.33E+10			
1979	4.89E+09	9.66E+08	1.65E+10	-1.20E+10	4.58E+10	4.58E+10	0.91807	1.292	1979	3.78E+09	8.87E+08	1.51E+10	-1.10E+10	4.99E+10	4.99E+10	4.99E+10			
1980	7.24E+09	6.33E+08	2.20E+10	-1.70E+10	6.03E+10	6.03E+10	1.0519	1.3015	1980	5.56E+09	6.66E+08	2.32E+10	-1.79E+10	5.74E+10	5.74E+10	5.74E+10			
1981	4.01E+09	9.21E+08	2.07E+10	-2.17E+10	7.11E+10	7.11E+10	0.89814	1.1792	1981	3.40E+09	8.27E+08	1.86E+10	-1.95E+10	7.91E+10	7.91E+10	7.91E+10			
1982	3.56E+09	2.42E+09	2.18E+10	-2.19E+10	8.05E+10	8.05E+10	0.84226	1.104	1982	3.22E+09	2.04E+09	1.83E+10	-1.84E+10	9.55E+10	9.55E+10	9.55E+10			
1983	3.48E+09	2.32E+09	2.31E+10	-1.95E+10	9.15E+10	9.15E+10	0.7817	1.069	1983	3.26E+09	1.82E+09	1.80E+10	-1.53E+10	1.17E+11	1.17E+11	1.17E+11			
1984	2.28E+09	3.78E+09	2.80E+10	-2.59E+10	1.07E+11	1.07E+11	0.51397	1.025	1984	2.23E+09	1.94E+09	1.44E+10	-1.33E+10	2.09E+11	2.09E+11	2.09E+11			
1985	1.74E+09	4.85E+09	3.97E+10	-2.85E+10	1.23E+11	1.23E+11	0.35597	1.0153	1985	1.71E+09	1.73E+09	1.41E+10	-1.02E+10	3.46E+11	3.46E+11	3.46E+11			
1986	2.07E+09	3.59E+09	4.55E+10	-3.22E+10	1.42E+11	1.42E+11	0.37443	1.1732	1986	1.76E+09	1.34E+09	1.70E+10	-1.21E+10	3.80E+11	3.80E+11	3.80E+11			
1987	3.18E+09	2.27E+09	4.86E+10	-3.52E+10	1.65E+11	1.65E+11	0.36524	1.2931	1987	2.46E+09	8.28E+08	1.78E+10	-1.29E+10	4.50E+11	4.50E+11	4.50E+11			
1988	2.08E+09	2.40E+09	5.79E+10	-4.70E+10	1.98E+11	1.98E+11	0.31253	1.3439	1988	1.54E+09	7.50E+08	1.81E+10	-1.47E+10	6.34E+11	6.34E+11	6.34E+11			
1989	2.10E+09	2.03E+09	6.60E+10	-5.34E+10	2.33E+11	2.33E+11	0.30005	1.2818	1989	1.64E+09	6.10E+08	1.98E+10	-1.60E+10	7.78E+11	7.78E+11	7.78E+11			
1990	2.42E+09	1.96E+09	7.07E+10	-5.40E+10	2.64E+11	2.64E+11	0.2743	1.3568	1990	1.79E+09	5.37E+08	1.94E+10	-1.48E+10	9.63E+11	9.63E+11	9.63E+11			
1991	2.97E+09	2.10E+09	7.42E+10	-5.87E+10	2.98E+11	2.98E+11	0.25486	1.3682	1991	2.17E+09	5.35E+08	1.89E+10	-1.50E+10	1.17E+12	1.17E+12	1.17E+12			
1992	2.98E+09	2.37E+09	7.81E+10	-6.53E+10	3.27E+11	3.27E+11	0.23822	1.4084	1992	2.12E+09	5.64E+08	1.86E+10	-1.56E+10	1.37E+12	1.37E+12	1.37E+12			
1993	1.02E+09		9.00E+10	-7.43E+10	3.65E+11	3.65E+11	0.21429	1.3963	1993	7.31E+08	0.00E+00	1.93E+10	-1.59E+10	1.70E+12	1.70E+12	1.70E+12			

Table A-13. Regression Data for US

REGRESSION ANALYSIS																
COUNTRY/US																
Currency	C	BANKS	FORDEBT	EXPORT	IMPORT	C	GDP	SDR RATE	\$US/SDR Rate	YEAR	BANKS	FORDEBT	EXPORT	IMPORT	GDP	
YEAR																Values Expressed in SDR
1964		1.67E+10	1.31E+10	3.36E+10	-2.81E+10		6.48E+11	1	1	1964	1.67E+10	1.31E+10	3.36E+10	-2.81E+10	6.48E+11	
1965		1.55E+10	1.30E+10	3.54E+10	-3.15E+10		7.03E+11	1	1	1965	1.55E+10	1.30E+10	3.54E+10	-3.15E+10	7.03E+11	
1966		1.49E+10	1.08E+10	3.90E+10	-3.71E+10		7.70E+11	1	1	1966	1.49E+10	1.08E+10	3.90E+10	-3.71E+10	7.70E+11	
1967		1.48E+10	1.29E+10	4.14E+10	-3.99E+10		8.14E+11	1	1	1967	1.48E+10	1.29E+10	4.14E+10	-3.99E+10	8.14E+11	
1968		1.57E+10	1.25E+10	4.53E+10	-4.66E+10		8.89E+11	1	1	1968	1.57E+10	1.25E+10	4.53E+10	-4.66E+10	8.89E+11	
1969		1.70E+10	1.04E+10	4.93E+10	-5.05E+10		9.60E+11	1	1	1969	1.70E+10	1.04E+10	4.93E+10	-5.05E+10	9.60E+11	
1970		1.45E+10	1.98E+10	5.70E+10	-5.58E+10		1.01E+12	1	1	1970	1.45E+10	1.98E+10	5.70E+10	-5.58E+10	1.01E+12	
1971		1.23E+10	4.61E+10	5.93E+10	-6.24E+10		1.10E+12	1.003	1.003	1971	1.23E+10	4.60E+10	5.91E+10	-6.22E+10	1.09E+12	
1972		1.32E+10	5.45E+10	6.62E+10	-7.42E+10		1.21E+12	1.0857	1.0857	1972	1.21E+10	5.02E+10	6.10E+10	-6.83E+10	1.11E+12	
1973		1.44E+10	5.47E+10	9.18E+10	-9.12E+10		1.35E+12	1.1921	1.1921	1973	1.21E+10	4.59E+10	7.70E+10	-7.65E+10	1.13E+12	
1974		1.59E+10	5.88E+10	1.24E+11	-1.28E+11		1.46E+12	1.2026	1.2026	1974	1.32E+10	4.89E+10	1.03E+11	-1.06E+11	1.21E+12	
1975		1.62E+10	6.65E+10	1.36E+11	-1.23E+11		1.58E+12	1.2142	1.2142	1975	1.34E+10	5.48E+10	1.12E+11	-1.01E+11	1.31E+12	
1976		1.88E+10	7.81E+10	1.49E+11	-1.51E+11		1.77E+12	1.1545	1.1545	1976	1.62E+10	6.76E+10	1.29E+11	-1.31E+11	1.53E+12	
1977		1.93E+10	1.10E+11	1.59E+11	-1.83E+11		1.97E+12	1.1675	1.1675	1977	1.65E+10	9.39E+10	1.36E+11	-1.56E+11	1.69E+12	
1978		1.87E+10	1.33E+11	1.86E+11	-2.12E+11		2.23E+12	1.252	1.252	1978	1.49E+10	1.06E+11	1.49E+11	-1.70E+11	1.78E+12	
1979		1.90E+10	1.19E+11	2.29E+11	-2.53E+11		2.49E+12	1.292	1.292	1979	1.47E+10	9.21E+10	1.77E+11	-1.96E+11	1.93E+12	
1980		2.68E+10	1.30E+11	2.79E+11	-2.94E+11		2.71E+12	1.3015	1.3015	1980	2.06E+10	9.97E+10	2.15E+11	-2.26E+11	2.08E+12	
1981		3.01E+10	1.37E+11	3.03E+11	-3.18E+11		3.03E+12	1.1792	1.1792	1981	2.55E+10	1.16E+11	2.57E+11	-2.69E+11	2.57E+12	
1982		3.40E+10	1.50E+11	2.83E+11	-3.03E+11		3.15E+12	1.104	1.104	1982	3.08E+10	1.35E+11	2.56E+11	-2.75E+11	2.85E+12	
1983		3.38E+10	1.66E+11	2.77E+11	-3.28E+11		3.41E+12	1.069	1.069	1983	3.16E+10	1.56E+11	2.59E+11	-3.07E+11	3.19E+12	
1984		3.49E+10	2.06E+11	3.02E+11	-4.05E+11		3.78E+12	1.025	1.025	1984	3.41E+10	2.01E+11	2.95E+11	-3.95E+11	3.69E+12	
1985		4.32E+10	2.25E+11	3.04E+11	-4.18E+11		4.04E+12	1.0153	1.0153	1985	4.25E+10	2.21E+11	2.99E+11	-4.11E+11	3.98E+12	
1986		4.85E+10	2.63E+11	3.19E+11	-4.52E+11		4.27E+12	1.1732	1.1732	1986	4.13E+10	2.25E+11	2.72E+11	-3.85E+11	3.64E+12	
1987		4.58E+10	3.00E+11	3.64E+11	-5.07E+11		4.54E+12	1.2931	1.2931	1987	3.54E+10	2.32E+11	2.81E+11	-3.92E+11	3.51E+12	
1988		4.78E+10	3.62E+11	4.44E+11	-5.52E+11		4.90E+12	1.3439	1.3439	1988	3.56E+10	2.70E+11	3.31E+11	-4.11E+11	3.65E+12	
1989		7.46E+10	3.93E+11	5.08E+11	-5.88E+11		5.25E+12	1.2818	1.2818	1989	5.82E+10	3.07E+11	3.96E+11	-4.58E+11	4.10E+12	
1990		8.33E+10	4.22E+11	5.57E+11	-6.26E+11		5.52E+12	1.3568	1.3568	1990	6.14E+10	3.11E+11	4.11E+11	-4.61E+11	4.07E+12	
1991		7.77E+10	4.92E+11	6.02E+11	-6.21E+11		5.72E+12	1.3682	1.3682	1991	5.68E+10	3.59E+11	4.40E+11	-4.54E+11	4.18E+12	
1992		7.13E+10	5.50E+11	6.41E+11	-6.70E+11		6.04E+12	1.4084	1.4084	1992	5.06E+10	3.90E+11	4.55E+11	-4.76E+11	4.29E+12	
1993		7.34E+10	6.24E+10	6.62E+11	-7.25E+11		6.38E+12	1.3963	1.3963	1993	5.26E+10	4.47E+10	4.74E+11	-5.19E+11	4.57E+12	

Table A-14. Regression Data for Zimbabwe

REGRESSION ANALYSIS														
COUNTRY		Zimbabwe												
GDP	1993	5.69E+10	SDR value											
Currency	US	C	C	C	C	C	C	C	C	C	C	C	C	C
YEAR	BANKS	FORDEBT	EXPORT	IMPORT	GDP	SDR RATE	\$US/SDR Rate	YEAR	BANKS	FORDEBT	EXPORT	IMPORT	GDP	
1964	0.00E+00	-	2.50E+08	-2.56E+08	7.46E+08	1.4	1	1964	0.00E+00	0.00E+00	3.19E+16	3.34E+16	5.33E+08	
1965	0.00E+00	-	2.43E+08	-2.78E+08	8.42E+08	1.4	1	1965	0.00E+00	0.00E+00	3.01E+16	3.94E+16	6.01E+08	
1966	8.70E+07	-	0.00E+00	0.00E+00	7.33E+08	1.4	1	1966	8.70E+07	0.00E+00	0.00E+00	0.00E+00	5.24E+08	
1967	8.90E+07	-	0.00E+00	0.00E+00	7.94E+08	1.4	1	1967	8.90E+07	0.00E+00	0.00E+00	0.00E+00	5.67E+08	
1968	3.20E+07	-	0.00E+00	0.00E+00	8.52E+08	1.4	1	1968	3.20E+07	0.00E+00	0.00E+00	0.00E+00	6.09E+08	
1969	5.60E+07	-	2.96E+08	-2.71E+08	9.77E+08	1.4	1	1969	5.60E+07	0.00E+00	4.47E+16	3.75E+16	6.98E+08	
1970	5.70E+07	-	3.24E+08	-3.15E+08	1.09E+09	1.3963	1	1970	5.70E+07	0.00E+00	5.38E+16	5.09E+16	7.78E+08	
1971	3.70E+07	-	3.55E+08	-3.79E+08	1.26E+09	1.3724	1.003	1971	3.69E+07	0.00E+00	6.69E+16	7.63E+16	9.20E+08	
1972	8.20E+07	-	4.17E+08	-3.76E+08	1.43E+09	1.4127	1.0857	1972	7.55E+07	0.00E+00	8.71E+16	7.08E+16	1.01E+09	
1973	1.56E+08	-	0.00E+00	0.00E+00	1.54E+09	1.3678	1.1921	1973	1.31E+08	0.00E+00	0.00E+00	0.00E+00	1.12E+09	
1974	9.40E+07	0.00E+00	5.77E+08	-5.86E+08	1.83E+09	1.4885	1.2026	1974	7.82E+07	0.00E+00	1.50E+17	1.55E+17	1.23E+09	
1975	9.40E+07	0.00E+00	5.90E+08	-6.13E+08	2.00E+09	1.3672	1.2142	1975	7.74E+07	0.00E+00	1.86E+17	2.01E+17	1.46E+09	
1976	8.70E+07	9.20E+07	6.17E+08	-5.33E+08	2.17E+09	1.3904	1.1545	1976	7.54E+07	6.62E+07	1.97E+17	1.47E+17	1.56E+09	
1977	7.90E+07	1.00E+08	6.10E+08	-5.58E+08	2.20E+09	1.2728	1.1675	1977	6.77E+07	7.86E+07	2.30E+17	1.92E+17	1.73E+09	
1978	1.54E+08	2.33E+08	6.75E+08	-5.93E+08	2.36E+09	1.1369	1.252	1978	1.23E+08	2.05E+08	3.53E+17	2.72E+17	2.07E+09	
1979	3.08E+08	3.61E+08	7.98E+08	-8.03E+08	2.82E+09	1.1259	1.292	1979	2.38E+08	3.21E+08	5.02E+17	5.09E+17	2.51E+09	
1980	3.26E+08	4.35E+08	1.04E+09	-1.15E+09	3.44E+09	1.2434	1.3015	1980	2.50E+08	3.50E+08	7.04E+17	8.49E+17	2.77E+09	
1981	2.67E+08	5.74E+08	1.12E+09	-1.44E+09	4.43E+09	1.198	1.1792	1981	2.26E+08	4.79E+08	8.69E+17	1.45E+18	3.70E+09	
1982	2.24E+08	8.41E+08	1.14E+09	-1.45E+09	5.20E+09	0.9859	1.104	1982	2.03E+08	8.53E+08	1.34E+18	2.16E+18	5.27E+09	
1983	1.86E+08	9.87E+08	1.35E+09	-1.54E+09	6.31E+09	0.864	1.069	1983	1.74E+08	1.14E+09	2.42E+18	3.19E+18	7.30E+09	
1984	1.56E+08	1.44E+09	1.71E+09	-1.67E+09	6.40E+09	0.679	1.025	1984	1.52E+08	2.12E+09	6.33E+18	6.07E+18	9.43E+09	
1985	2.21E+08	1.70E+09	2.10E+09	-2.02E+09	7.30E+09	0.5547	1.0153	1985	2.18E+08	3.06E+09	1.43E+19	1.32E+19	1.32E+10	
1986	2.16E+08	2.22E+09	2.56E+09	-2.20E+09	8.38E+09	0.4872	1.1732	1986	1.84E+08	4.56E+09	2.76E+19	2.04E+19	1.72E+10	
1987	2.65E+08	2.52E+09	2.79E+09	-2.42E+09	9.27E+09	0.4239	1.2931	1987	2.05E+08	5.93E+09	4.33E+19	3.27E+19	2.19E+10	
1988	2.58E+08	2.83E+09	3.43E+09	-2.84E+09	1.09E+10	0.3825	1.3439	1988	1.92E+08	7.39E+09	8.06E+19	5.49E+19	2.86E+10	
1989	1.77E+08	3.24E+09	4.14E+09	-3.73E+09	1.32E+10	0.3352	1.2818	1989	1.38E+08	9.65E+09	1.53E+20	1.24E+20	3.93E+10	
1990	2.19E+08	4.04E+09	0.00E+00	0.00E+00	1.52E+10	0.2666	1.3568	1990	1.61E+08	1.51E+10	0.00E+00	0.00E+00	5.69E+10	
Values Expressed in SDR														

Table A-15. Regression Analysis for Argentina

SUMMARY OUTPUT									
Regression Statistics									
Multiple R	0.953756818								
R Square	0.909652067								
Adjusted R Square	0.895196398								
Standard Error	13063371595								
Observations	30								
ANOVA	n=30, k=5	99% confidence			4.14				
	df	SS	MS	F	Significance F				
Regression	4	4.29544E+22	1.07E+22	62.92701	1.09994E-12				
Residual	25	4.26629E+21	1.71E+20						
Total	29	4.72207E+22							
	Coefficients	Standard Error	t Stat	P-value	critical t ₉₀	crit t ₉₅	critical t ₉₉		
Intercept	1015614574	4513355726	0.225024	0.82379	1.708	2.06	2.787		
BANKS	0.539334625	1.019124335	0.529214	0.601325					
FORDEBT	0.000109191	0.000598677	0.182388	0.856749					
EXPORT	3.565691775	1.731951966	2.058771	0.050079					
IMPORT	-9.301978676	1.707378865	-5.4481	1.17E-05					
RESIDUAL OUTPUT									
Observation	Predicted GDP	Residuals	DW Test		BANKS	FORDEBT	EXPORT	IMPORT	
1	1098132772	18782582934			BANKS	1			
2	1142897546	20077261605	1.68E+18	4.03E+20	FORDEBT	0.028545	1		
3	1132110853	19086247416	9.82E+17	3.64E+20	EXPORT	0.430936	0.030168	1	
4	11595401632	5547455511	1.83E+20	3.08E+19	IMPORT	-0.45467	-0.01179	-0.87928	1
5	38190281606	-18190281606	5.63E+20	3.31E+20					
6	38070549319	-15213406462	8.86E+18	2.31E+20					
7	33547762904	-11047762904	1.74E+19	1.22E+20	Durbin Watson test for autocorrelation of residuals				
8	24872748349	-927270360.5	1.02E+20	8.6E+17	DW Statistic	1.20			
9	48650073502	-9968916751	8.18E+19	9.94E+19	95% Confidence d _L	1.14	d _U 1.74		
10	71520236844	-13496364165	1.24E+19	1.82E+20					
11	91503796839	-11464593964	4.13E+18	1.31E+20					
12	22382350196	-2319495939	8.36E+19	5.38E+18					
13	30071134033	-6272211412	1.56E+19	3.93E+19					
14	42624586131	-13787003859	5.65E+19	1.9E+20					
15	48698684344	-8652777688	2.64E+19	7.49E+19					
16	79313491046	-12474841890	1.46E+19	1.56E+20					
17	1.22253E+11	28868750320	1.71E+21	8.33E+20					
18	85203811052	3392680176	6.49E+20	1.15E+19					
19	40302874348	498514825.9	8.38E+18	2.49E+17					
20	41402779210	3560695666	9.38E+18	1.27E+19					
21	34609412726	10534422890	4.86E+19	1.11E+20					
22	64000228848	-3668146510	2.02E+20	1.35E+19					
23	61592423540	3344161826	4.92E+19	1.12E+19					
24	47250458016	-3393315158	4.54E+19	1.15E+19					
25	60425096498	1303449523	2.21E+19	1.7E+18					
26	17194552886	-3442380263	2.25E+19	1.18E+19					
27	72816498114	14013948926	3.05E+20	1.96E+20					
28	1.10215E+11	16439396369	5.88E+18	2.7E+20					
29	1.70436E+11	-4027343021	4.19E+20	1.62E+19					
30	7103456034	-7103456034	9.46E+18	5.05E+19					

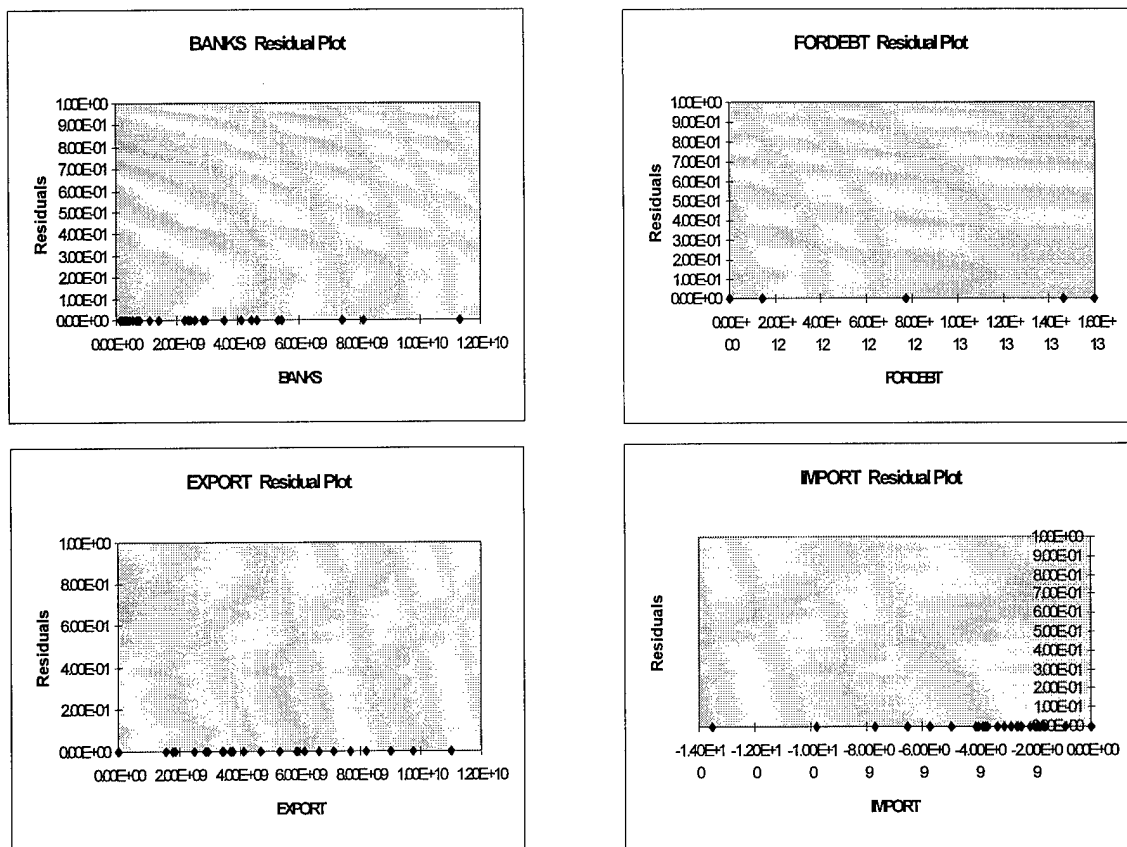


Figure A-1. Residual Data for Argentina

Table A-16. Regression Analysis for Argentina (Adjusted)

SUMMARY OUTPUT							
Regression Statistics							
Multiple R	0.968958884						
R Square	0.93888132						
Adjusted R Square	0.927239666						
Standard Error	10943873464						
Observations	26						
ANOVA							
n=26, k=5		99% confidence Critical F (4,21):		4.37			
	df	SS	MS	F	Significance F		
Regression	4	3.86365E+22	9.66E+21	80.64845	1.95248E-12		
Residual	21	2.51514E+21	1.2E+20				
Total	25	4.11517E+22					
Coefficients							
	Coefficients	Standard Error	t Stat	P-value	critical t ₉₀	crit t ₉₅	critical t ₉₉
Intercept	-8827713654	4884100678	-1.80744	0.085042	1.721	2.08	2.831
BANKS	1.70914047	1.553978358	1.099848	0.283847			
FORDEBT	0.00027225	0.000510562	0.533236	0.599469			
EXPORT	5.094937229	1.702166086	2.993208	0.006929			
IMPORT	-8.52700679	1.459878807	-5.8409	8.49E-06			
RESIDUAL OUTPUT							
Observation	Predicted GDP	Residuals	DW Test		BANKS	FORDEBT	EXPORT
1	6971794979	10171062163			1		
2	31391073157	-11391073157	4.65E+20	1.3E+20	FORDEBT	0.043434	1
3	31011643972	-8154501115	1.05E+19	6.65E+19	EXPORT	0.734395	-0.05598
4	26377397929	-3877397929	1.83E+19	1.5E+19	IMPORT	-0.70655	0.055172
5	16755824446	7189653542	1.22E+20	5.17E+19			
6	42086450644	-3405293893	1.12E+20	1.16E+19			
7	69256841758	-11232969079	6.13E+19	1.26E+20	Durbin Watson test for autocorrelation of residuals		
8	90363896725	-10324693850	8.25E+17	1.07E+20	DW Statistic	2.01	
9	14034720984	6028133272	2.67E+20	3.63E+19	95% Confidence	d _L 1.06	d _U 1.76
10	24888364782	-1089442162	5.07E+19	1.19E+18			
11	39650131909	-10812549636	9.45E+19	1.17E+20			
12	48400464016	-8354557360	6.04E+18	6.98E+19			
13	82740171202	-15901522047	5.7E+19	2.53E+20			
14	1.22696E+11	28425150388	1.96E+21	8.08E+20			
15	83096776937	5499714291	5.26E+20	3.02E+19			
16	36920323553	3881065621	2.62E+18	1.51E+19			
17	38656442049	6307032827	5.89E+18	3.98E+19			
18	31383485852	13760349764	5.56E+19	1.89E+20			
19	67465304729	-7133222391	4.37E+20	5.09E+19			
20	63186784939	1749800427	7.89E+19	3.06E+18			
21	45461921771	-1604778914	1.13E+19	2.58E+18			
22	62029075344	-300529323.3	1.7E+18	9.03E+16			
23	12266612934	1485559689	3.19E+18	2.21E+18			
24	78786111007	8044336033	4.3E+19	6.47E+19			
25	1.15628E+11	11026152482	8.89E+18	1.22E+20			
26	1.76394E+11	-9985479645	4.41E+20	9.97E+19			

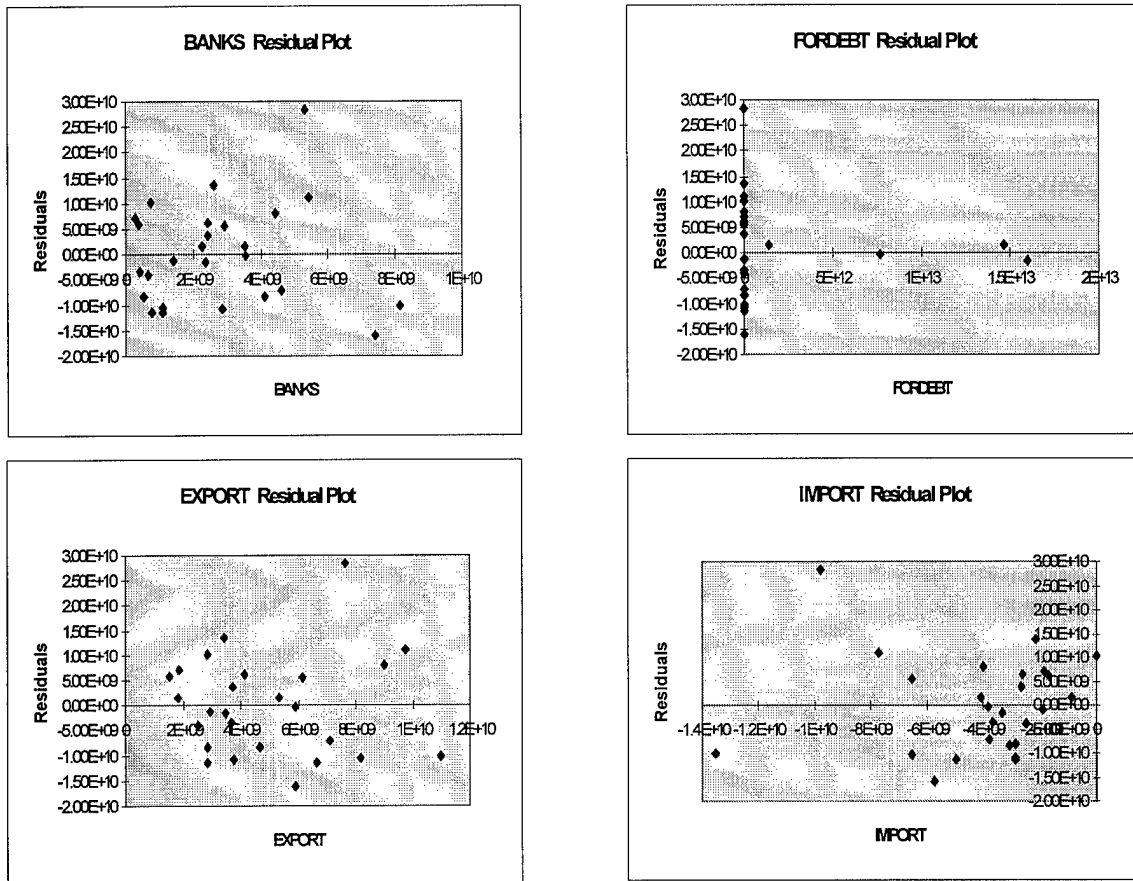


Figure A-2. Residual Data for Argentina (Adjusted)

Table A-17. Regression Analysis for Argentina (No foreign Debt)

SUMMARY OUTPUT							
Regression Statistics							
Multiple R	0.96853176						
R Square	0.93805377						
Adjusted R Square	0.929606556						
Standard Error	10764399992						
Observations	26						
		99% confidence					
ANOVA	n=26, k=4	Critical F (3,22):	4.82				
	df	SS	MS	F	Significance F		
Regression	3	3.86025E+22	1.29E+22	111.0489	1.93638E-13		
Residual	22	2.54919E+21	1.16E+20				
Total	25	4.11517E+22					
Coefficients							
	Coefficients	Standard Error	t Stat	P-value	critical t ₉₀	crit t ₉₅	critical t ₉₉
Intercept	-8279337073	4696303537	-1.76295	0.091797	1.717	2.074	2.819
BANKS	1.818484878	1.515128005	1.200219	0.24282			
EXPORT	5.036361554	1.670761429	3.014411	0.008378			
IMPORT	-8.491395368	1.434434327	-5.91968	5.88E-06			
RESIDUAL OUTPUT							
Observation	Predicted GDP	Residuals	DW Test				
1	7432305873	9710551270					
2	31753445497	-11753445497	4.61E+20	1.38E+20		BANKS	EXPORTS
3	31349741854	-8492598997	1.06E+19	7.21E+19		BANKS	1
4	26763895554	-4263895554	1.79E+19	1.82E+19		EXPORTS	0.734395
5	17162218193	6783259796	1.22E+20	4.6E+19		IMPORTS	-0.70655
6	42334681200	-3653524449	1.09E+20	1.33E+19			-0.84584
7	69360565455	-11336692776	5.9E+19	1.29E+20			1
8	90320574203	-10281371328	1.11E+18	1.06E+20			
9	14473783084	5589071173	2.52E+20	3.12E+19	Durbin Watson test for autocorrelation of residuals		
10	25348673583	-1549750962	5.1E+19	2.4E+18	DW Statistic	2.01	
11	40187918445	-11350336172	9.61E+19	1.29E+20	95% Confidence d _L	1.14	d _U 1.65
12	49014365409	-8968458753	5.67E+18	8.04E+19			
13	83548364634	-16709715478	5.99E+19	2.79E+20			
14	1.23028E+11	28093300171	2.01E+21	7.89E+20			
15	83372795844	5223695385	5.23E+20	2.73E+19			
16	37422246172	3379143002	3.4E+18	1.14E+19			
17	39134112734	5829362142	6E+18	3.4E+19			
18	31936622869	13207212747	5.44E+19	1.74E+20			
19	67969325961	-7637243623	4.34E+20	5.83E+19			
20	59682250409	5254334957	1.66E+20	2.76E+19			
21	41603117214	2254025643	9E+18	5.08E+18			
22	60386759351	1341786669	8.32E+17	1.8E+18			
23	12532198704	1219973919	1.48E+16	1.49E+18			
24	79149645202	7680801838	4.17E+19	5.9E+19			
25	1.15927E+11	10727122971	9.28E+18	1.15E+20			
26	1.76705E+11	-10296608094	4.42E+20	1.06E+20			

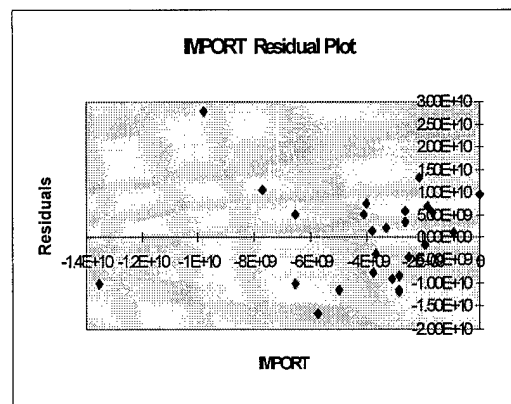
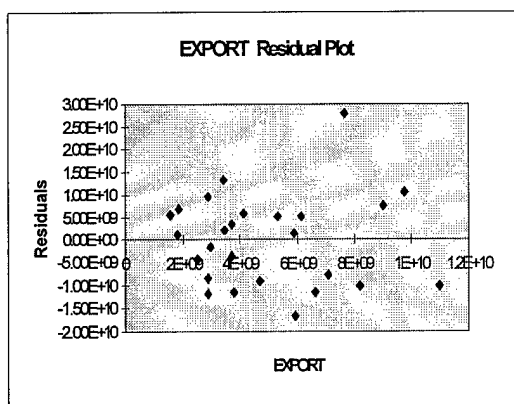
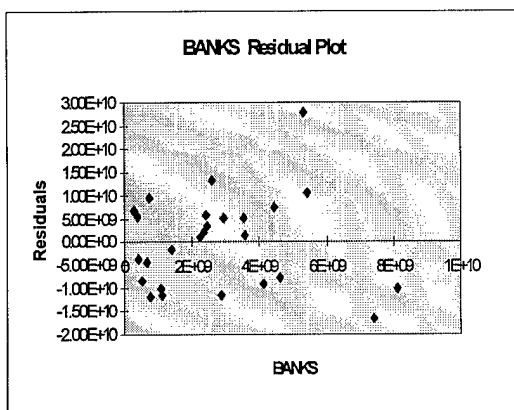


Figure A-3. Residual Plots for Argentina (No Foreign Debt)

Table A-18. Regression Analysis for Argentina (Intercept 0)

SUMMARY OUTPUT							
Regression Statistics							
Multiple R	0.964003372						
R Square	0.929302501						
Adjusted R Square	0.879676632						
Standard Error	11246874087						
Observations	26						
ANOVA							
	n=26, k=3	99% confidence					
		Critical F (2,23):		5.66			
	df	SS	MS	F	Significance F		
Regression	3	3.82423E+22	1.27E+22	100.7766	5.24054E-13		
Residual	23	2.90932E+21	1.26E+20				
Total	26	4.11517E+22					
	Coefficients	Standard Error	t Stat	P-value	critical t ₉₀	crit t ₉₅	critical t ₉₉
Intercept	0				1.704	2.069	2.807
BANKS	1.921787792	1.581853642	1.214896	0.236731			
EXPORT	3.294564051	1.407717383	2.340359	0.028306			
IMPORT	-8.913663108	1.477685459	-6.03218	3.76E-06			
RESIDUAL OUTPUT							
Observation	Predicted GDP	Residuals	DW Test				
1	10810179870	6332677273					
2	36341207747	-16341207747	5.14E+20	2.67E+20		BANKS	EXPORTS IMPORTS
3	35914570857	-13057428000	1.08E+19	1.7E+20	BANKS	1	
4	31813931081	-9313931081	1.4E+19	8.67E+19	EXPORTS	0.734395	1
5	23040799674	904678314.4	1.04E+20	8.18E+17	IMPORTS	-0.70655	-0.84584 1
6	45797220730	-7116063979	6.43E+19	5.06E+19			
7	68303872109	-10279999430	1E+19	1.06E+20			
8	87245992913	-7206790038	9.44E+18	5.19E+19			
9	20814819646	-751965388.9	4.17E+19	5.65E+17	Durbin Watson test for autocorrelation of residuals		
10	29446272911	-5647350291	2.4E+19	3.19E+19	DW Statistic	1.71	
11	43420505635	-14582923363	7.98E+19	2.13E+20	95% Confidence d _L 1.14	d _U 1.65	
12	50897587035	-10851680379	1.39E+19	1.18E+20			
13	84715467431	-17876818276	4.94E+19	3.2E+20			
14	1.22695E+11	28426309930	2.14E+21	8.08E+20			
15	84038084771	4558406457	5.7E+20	2.08E+19			
16	40617987584	183401590.5	1.91E+19	3.36E+16			
17	41605444742	3358030134	1.01E+19	1.13E+19			
18	35423123007	9720712609	4.05E+19	9.45E+19			
19	65984480008	-5652397670	2.36E+20	3.19E+19			
20	60826107204	4110478162	9.53E+19	1.69E+19			
21	45514039422	-1656896565	3.33E+19	2.75E+18			
22	60404751583	1323794438	8.88E+18	1.75E+18			
23	18294465180	-4542292557	3.44E+19	2.06E+19			
24	73931202625	12899244415	3.04E+20	1.66E+20			
25	1.11087E+11	15567411504	7.12E+18	2.42E+20			
26	1.72413E+11	-6004760239	4.65E+20	3.61E+19			

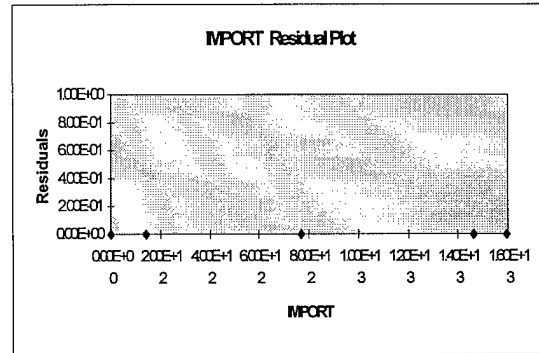
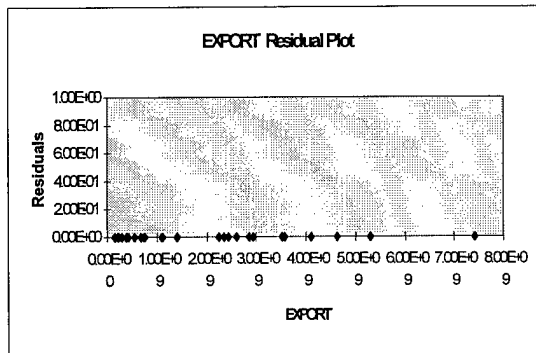
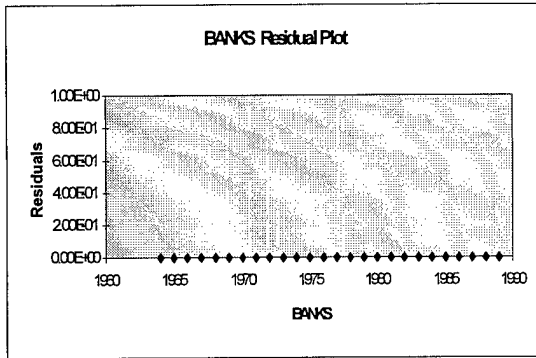


Figure A-4. Residual Plots for Argentina (Intercept 0)

Table A-19. Regression Analysis for Brazil

SUMMARY OUTPUT									
Regression Statistics									
Multiple R	0.995378983								
R Square	0.990779321								
Adjusted R Square	0.989304012								
Standard Error	4.25347E+12								
Observations	30								
		99% confidence							
ANOVA	n=30, k=5	Critical F (4,25):			4.18				
	df	SS	MS	F	Significance F				
Regression	4	4.86004E+28	1.22E+28	671.5742	4.85452E-25				
Residual	25	4.523E+26	1.81E+25						
Total	29	4.90527E+28							
	Coefficients	Standard Error	t Stat	P-value	critical t ₉₀	crit t ₉₅	critical t ₉₉		
Intercept	9.6822E+11	1.22939E+12	0.787561	0.438357	1.708	2.06	2.787		
BANKS	-190.2916676	166.8794674	-1.14029	0.264971					
FORDEBT	-3660.185086	609000.7113	-0.00601	0.995252					
EXPORT	6312.179128	2106.349025	2.996739	0.006086					
IMPORT	-8229.261057	3003.926299	-2.7395	0.011184					
RESIDUAL OUTPUT									
Observation	Predicted GDP	Residuals	DW Test			BANKS	FORDEBT	EXPORT	IMPORT
1	9.38345E+11	-9.38345E+11				BANKS	1		
2	8.81837E+11	-8.81837E+11	3.19E+21	7.78E+23		FORDEBT	0.008132	1	
3	8.87358E+11	-8.87358E+11	3.05E+19	7.87E+23		EXPORT	0.289123	-0.14832	1
4	9.30364E+11	-9.30364E+11	1.85E+21	8.66E+23		IMPORT	-0.27547	0.148108	-0.99385
5	9.19327E+11	-9.19327E+11	1.22E+20	8.45E+23					
6	8.43404E+11	-8.43404E+11	5.76E+21	7.11E+23					
7	7.42362E+11	-7.42362E+11	1.02E+22	5.51E+23	Durbin Watson test for autocorrelation of residuals				
8	6.36982E+11	-6.36982E+11	1.11E+22	4.06E+23	DW Statistic	1.66			
9	2.35085E+11	-2.35085E+11	1.62E+23	5.53E+22	95% Confidence d _L	1.14	d _U 1.74		
10	-55914646507	55914646575	8.47E+22	3.13E+21					
11	1.34596E+11	-1.34596E+11	3.63E+22	1.81E+22					
12	2.88396E+11	-2.88291E+11	2.36E+22	8.31E+22					
13	-1.64542E+11	1.64705E+11	2.05E+23	2.71E+22					
14	-2.38373E+11	2.38498E+11	5.45E+21	5.69E+22					
15	-8.6681E+11	8.66931E+11	3.95E+23	7.52E+23					
16	-2.41674E+11	2.41773E+11	3.91E+23	5.85E+22					
17	1.70774E+11	-1.70619E+11	1.7E+23	2.91E+22					
18	-31104271547	31267004880	4.08E+22	9.78E+20					
19	2.34829E+11	-2.34651E+11	7.07E+22	5.51E+22					
20	1.49384E+11	-1.49273E+11	7.29E+21	2.23E+22					
21	-1.3166E+12	1.31671E+12	2.15E+24	1.73E+24					
22	-1.02026E+12	1.15896E+12	2.49E+22	1.34E+24					
23	68857697481	1.14792E+11	1.09E+24	1.32E+22					
24	-1670695137	1.17411E+11	6.86E+18	1.38E+22					
25	-83845431507	1.67923E+11	2.55E+21	2.82E+22					
26	1.18617E+14	8.58251E+12	7.08E+25	7.37E+25					
27	1.18601E+14	1.1983E+13	1.16E+25	1.44E+26					
28	1.16036E+14	-8.52922E+12	4.21E+26	7.27E+25					
29	1.20316E+14	-1.18718E+13	1.12E+25	1.41E+26					
30	-3.35317E+12	3.35317E+12	2.32E+26	1.12E+25					

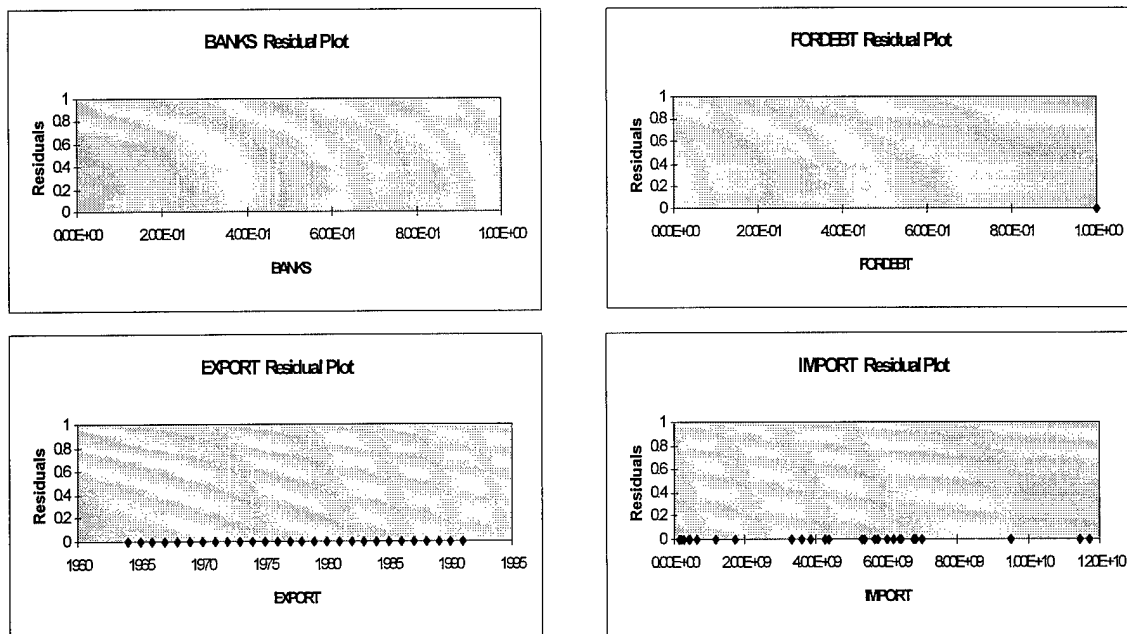


Figure A-5. Residual Plots Brazil

Table A-20. Regression Analysis of Brazil (No Foreign Debt)

SUMMARY OUTPUT								
Regression Statistics								
Multiple R	0.995596825							
R Square	0.991213037							
Adjusted R Square	0.990114667							
Standard Error	4.21465E+12							
Observations	28							
		99% confidence						
ANOVA	n=28, k=4	Critical F (3,24):			4.72			
	df	SS	MS	F	Significance F			
Regression	3	4.80909E+28	1.6E+28	902.4398	8.50254E-25			
Residual	24	4.26319E+26	1.78E+25					
Total	27	4.85172E+28						
	Coefficients	Standard Error	t Stat	P-value	critical t ₉₀	crit t ₉₅	critical t ₉₉	
Intercept	1.82431E+12	1.39346E+12	1.309193	0.202865	1.711	2.064	2.797	
BANKS	-399.5745504	239.1538686	-1.67078	0.107756				
EXPORT	6710.971213	2112.718679	3.176462	0.004066				
IMPORT	-7812.613562	2996.390939	-2.60734	0.015446				
RESIDUAL OUTPUT								
Observation	Predicted GDP	Residuals	DW Test			BANKS	EXPORT	IMPORT
1	1.64292E+12	-1.64292E+12			BANKS	1		
2	1.65451E+12	-1.65451E+12	1.34E+20	2.74E+24	EXPORT	0.437805	1	
3	1.74481E+12	-1.74481E+12	8.15E+21	3.04E+24	IMPORT	-0.41906	-0.99378	1
4	1.72164E+12	-1.72164E+12	5.37E+20	2.96E+24				
5	1.56221E+12	-1.56221E+12	2.54E+22	2.44E+24				
6	1.35004E+12	-1.35004E+12	4.5E+22	1.82E+24	Durbin Watson test for autocorrelation of residuals			
7	1.12876E+12	-1.12876E+12	4.9E+22	1.27E+24	DW Statistic	1.22		
8	2.84853E+11	-2.84853E+11	7.12E+23	8.11E+22	95% Confidence d _L	1.18	d _U 1.65	
9	-3.26199E+11	3.26199E+11	3.73E+23	1.06E+23				
10	73932199809	-73932118299	1.6E+23	5.47E+21				
11	4.56617E+11	-4.56512E+11	1.46E+23	2.08E+23				
12	-4.83714E+11	4.83877E+11	8.84E+23	2.34E+23				
13	-6.75257E+11	6.75381E+11	3.67E+22	4.56E+23				
14	-1.99173E+12	1.99185E+12	1.73E+24	3.97E+24				
15	-8.51063E+11	8.51163E+11	1.3E+24	7.24E+23				
16	-66985553775	67141178775	6.15E+23	4.51E+21				
17	-4.91567E+11	4.9173E+11	1.8E+23	2.42E+23				
18	3.54608E+11	-3.5443E+11	7.16E+23	1.26E+23				
19	1.26256E+11	-1.26145E+11	5.21E+22	1.59E+22				
20	-2.89988E+12	2.89999E+12	9.16E+24	8.41E+24				
21	-2.55447E+12	2.69317E+12	4.28E+22	7.25E+24				
22	-2.78983E+11	4.62633E+11	4.98E+24	2.14E+23				
23	-3.51247E+11	4.66987E+11	1.9E+19	2.18E+23				
24	-4.89984E+11	5.74062E+11	1.15E+22	3.3E+23				
25	1.19569E+14	7.63085E+12	4.98E+25	5.82E+25				
26	1.18759E+14	1.18248E+13	1.76E+25	1.4E+26				
27	1.16258E+14	-8.75119E+12	4.23E+26	7.66E+25				
28	1.19033E+14	-1.05878E+13	3.37E+24	1.12E+26				

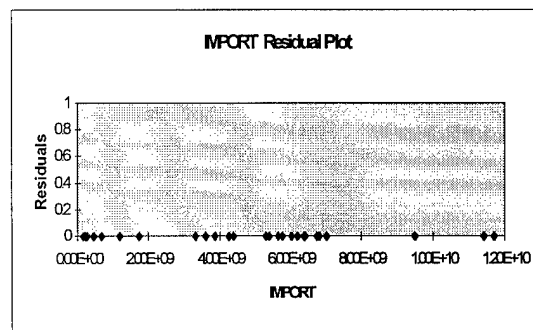
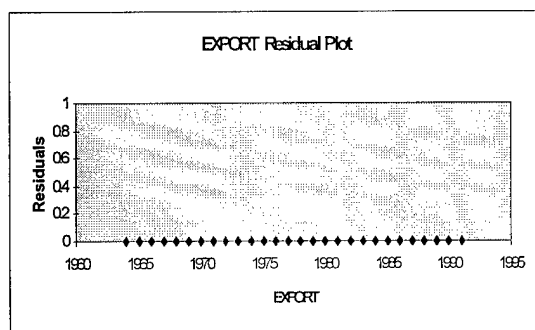
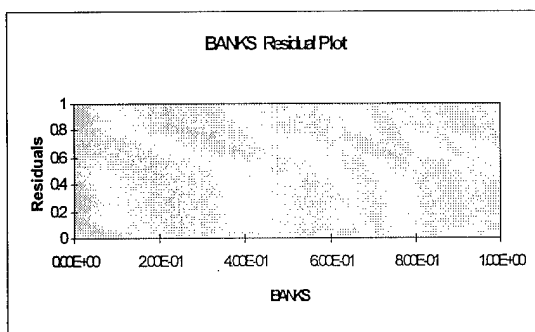


Figure A-6. Residual Plots for Brazil (No Foreign Debt)

Table A-21. Regression Analysis for Columbia

SUMMARY OUTPUT									
Regression Statistics									
Multiple R	0.998476929								
R Square	0.996956177								
Adjusted R Squ	0.996448874								
Standard Error	3868132544								
Observations	29								
		99% Confidence							
ANOVA	n=29, k=5	Critical F (4,25)		4.18					
	df	SS	MS	F	Significance F				
Regression	4	1.17617E+23	2.94E+22	1965.206	8.19886E-30				
Residual	24	3.59099E+20	1.5E+19						
Total	28	1.17976E+23							
	Coefficients	Standard Error	t Stat	P-value	Critical t ₉₀	Critical t ₉₅	Critical t ₉₉		
Intercept	5301350303	1665092988	3.183816	0.003994	1.711	2.064	2.797		
BANKS	-1.947042934	0.539886137	-3.6064	0.001415					
FORDEBT	0.582502485	0.471233773	1.236122	0.228375					
EXPORT	3.81613705	0.487714677	7.824528	4.66E-08					
IMPORT	-2.909044924	0.459926656	-6.32502	1.54E-06					
RESIDUAL OUTPUT									
Observation	Predicted GDP	Residuals	DW test		BANKS	FORDEBT	EXPORT	IMPORT	
1	52010863093	1749136907			BANKS	1			
2	51796703959	9000296041	5.26E+19	8.1E+19	FORDEBT	-0.520246433	1		
3	73501192711	110807288.7	7.9E+19	1.23E+16	EXPORT	-0.486654619	0.971251645	1	
4	73736731110	9346268890	8.53E+19	8.74E+19	IMPORT	0.545108078	-0.966448831	-0.97936	1
5	96462519647	-41519647.42	8.81E+19	1.72E+15					
6	1.1267E+11	-1717192500	2.81E+18	2.95E+18	Durbin Watson test for autocorrelation of residuals				
7	1.35498E+11	-2727637741	1.02E+18	7.44E+18					
8	1.58318E+11	-2427507703	9.01E+16	5.89E+18	DW statistic	1.49			
9	1.83522E+11	6087574931	7.25E+19	3.71E+19	95% Confidence d _L 1.12	d _U 1.74			
10	2.47739E+11	-4579462778	1.14E+20	2.1E+19					
11	4914945038	-4592945038	1.82E+14	2.11E+19					
12	4909159781	-4504159781	7.88E+15	2.03E+19					
13	3929183135	-3397183135	1.23E+18	1.15E+19					
14	3031038305	-2315038305	1.17E+18	5.36E+18					
15	2380721060	-1471721060	7.11E+17	2.17E+18					
16	385461336.9	803538663.1	5.18E+18	6.46E+17					
17	-956919911.2	2535919911	3E+18	6.43E+18					
18	-1925577169	3908577169	1.88E+18	1.53E+19					
19	-914190657.5	3411190657	2.47E+17	1.16E+19					
20	2364627920	689372080.5	7.41E+18	4.75E+17					
21	5048189874	-1191189874	3.54E+18	1.42E+18					
22	5525043276	-559043276.5	4E+17	3.13E+17					
23	6917469139	-129469139.1	1.85E+17	1.68E+16					
24	9243301217	-419301217	8.4E+16	1.76E+17					
25	11940352755	-209352754.7	4.41E+16	4.38E+16					
26	16121948078	-994948077.8	6.17E+17	9.9E+17					
27	23497582281	-3269582281	5.17E+18	1.07E+19					
28	27749825291	-1508825291	3.1E+18	2.28E+18					
29	34650602940	-1586602940	6.05E+15	2.52E+18					

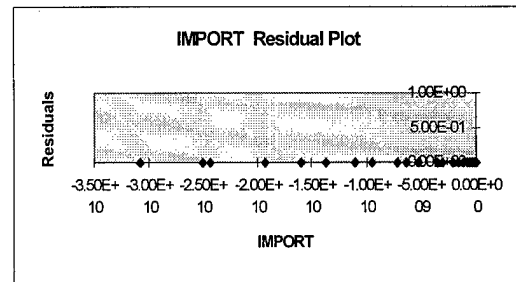
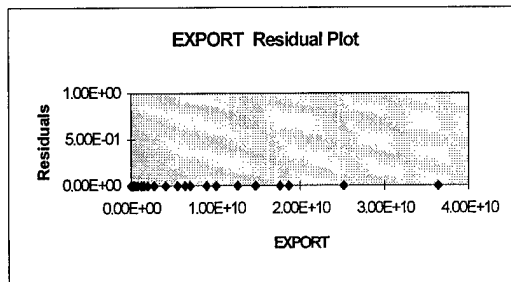
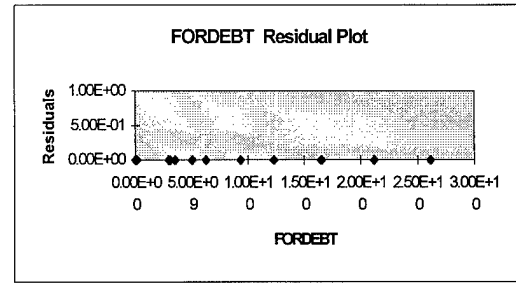
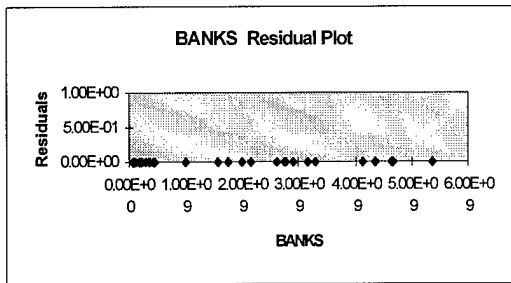


Figure A-7. Residual Plots for Columbia

Table A-22. Regression Analysis for India

SUMMARY OUTPUT								
Regression Statistics								
Multiple R	0.987071865							
R Square	0.974310867							
Adjusted R Square	0.969843192							
Standard Error	10617151894							
Observations	28							
		99% confidence						
ANOVA	n=28, k=5	Critical F (4,23):		4.26				
	df	SS	MS	F	Significance F			
Regression	4	9.83314E+22	2.46E+22	218.0801	6.28986E-18			
Residual	23	2.59265E+21	1.13E+20					
Total	27	1.00924E+23						
	Coefficients	Standard Error	t Stat	P-value	critical t ₉₀	crit t ₉₅	critical t ₉₉	
Intercept	30419093777	6707752473	4.534916	0.000148	1.714	2.069	2.807	
BANKS	0.35978894	1.689939177	0.212901	0.83328				
FORDEBT	0.179451157	0.170595307	1.051911	0.303767				
EXPORT	1.68232324	2.33099906	0.721718	0.477742				
IMPORT	-6.792191603	3.078029987	-2.20667	0.037592				
RESIDUAL OUTPUT								
Observation	Predicted GDP	Residuals	DW Test		BANKS	FORDEBT	EXPORT	IMPORT
1	55849259991	-4191282932		BANKS	1			
2	54573226529	191171377	1.92E+19	3.65E+16	FORDEBT	0.812854	1	
3	52530560947	-13499409944	1.87E+20	1.82E+20	EXPORT	0.784772	0.910662	1
4	53822582240	-7963300406	3.06E+19	6.34E+19	IMPORT	-0.80333	-0.96702	-0.97541
5	51109912207	-3037022852	2.43E+19	9.22E+18				
6	50103995679	3328998103	4.05E+19	1.11E+19	Durbin Watson test for autocorrelation of residuals			
7	50739137648	6230239331	8.42E+18	3.88E+19	DW Statistic	0.67		
8	53393332335	5141401310	1.19E+18	2.64E+19	95% Confidence d _L	1.10	d _U	1.75
9	46668955382	11475351013	4.01E+19	1.32E+20				
10	61345918597	1315762890	1.03E+20	1.73E+18				
11	70709195300	2692287963	1.89E+18	7.25E+18				
12	76811727206	-1529754352	1.78E+19	2.34E+18				
13	79773429514	2500266938	1.62E+19	6.25E+18				
14	88824750716	7524662583	2.52E+19	5.66E+19				
15	92411247140	5282142452	5.03E+18	2.79E+19				
16	1.29063E+11	-19269899906	6.03E+20	3.71E+20				
17	1.57932E+11	-23455290346	1.75E+19	5.5E+20				
18	1.63197E+11	-12351762644	1.23E+20	1.53E+20				
19	1.73093E+11	-5472973416	4.73E+19	3E+19				
20	1.85268E+11	3690635540	8.4E+19	1.36E+19				
21	1.86462E+11	3083599042	3.68E+17	9.51E+18				
22	1.86445E+11	9798058131	4.51E+19	9.6E+19				
23	1.67095E+11	15416762022	3.16E+19	2.38E+20				
24	1.67659E+11	14736547148	4.63E+17	2.17E+20				
25	1.84539E+11	12200346627	6.43E+18	1.49E+20				
26	2.02526E+11	1530275571	1.14E+20	2.34E+18				
27	2.08998E+11	-2079508780	1.3E+19	4.32E+18				
28	1.79895E+11	-13288302462	1.26E+20	1.77E+20				

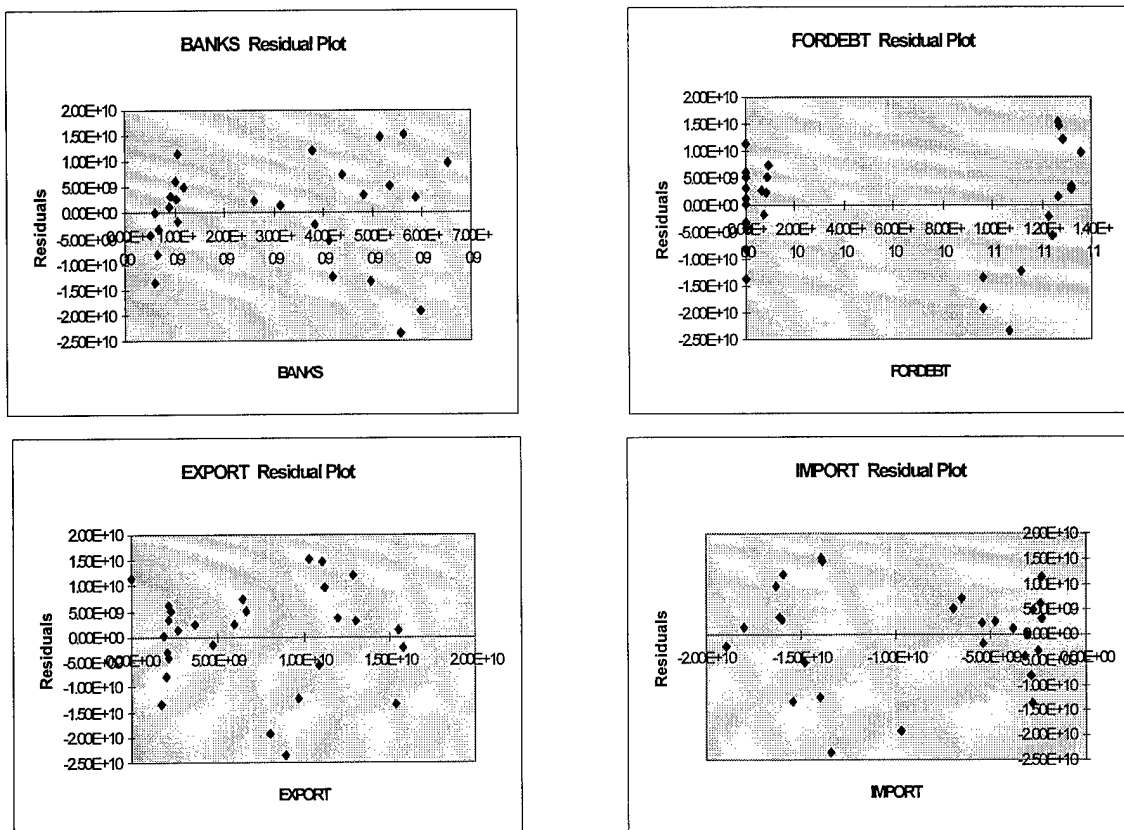


Figure A-8. Residual Plots for India

Table A-23. Regression Analysis for India (No Foreign Debt)

SUMMARY OUTPUT							
Regression Statistics							
Multiple R	0.986445628						
R Square	0.973074977						
Adjusted R Square	0.969709349						
Standard Error	10640686530						
Observations	28						
		99% confidence					
ANOVA	n=28, k=4	Critical F (3,25):		4.68			
	df	SS	MS	F	Significance F		
Regression	3	9.82066E+22	3.27E+22	289.1214	5.77643E-19		
Residual	24	2.71738E+21	1.13E+20				
Total	27	1.00924E+23					
	Coefficients	Standard Error	t Stat	P-value	critical t ₉₀	crit t ₉₅	critical t ₉₉
Intercept	24573858393	3765480641	6.526088	9.48E-07	1.711	2.064	2.797
BANKS	0.889776515	1.616661793	0.550379	0.587146			
EXPORT	0.211921471	1.869504997	0.113357	0.91069			
IMPORT	-9.560057332	1.600622956	-5.97271	3.64E-06			
RESIDUAL OUTPUT							
Observation	Predicted GDP	Residuals	DW Test			BANKS	EXPORT
						IMPORT	
1	55971338254	-4313361195			BANKS	1	
2	54737018877	27379028.7	1.88E+19	7.5E+14	EXPORT	0.784772	1
3	52228716941	-13197565938	1.75E+20	1.74E+20	IMPORT	-0.80333	-0.97541
4	53454206248	-7594924414	3.14E+19	5.77E+19			
5	49434053041	-1361163686	3.89E+19	1.85E+18	Durbin Watson test for autocorrelation of residuals		
6	47985682918	5447310865	4.64E+19	2.97E+19	DW Statistic	0.57	
7	48892293744	8077083236	6.92E+18	6.52E+19	95% Confidenced _L	1.18	d _U 1.65
8	52483084444	6051649202	4.1E+18	3.66E+19			
9	47848903721	10295402673	1.8E+19	1.06E+20			
10	62652883771	8797716.758	1.06E+20	7.74E+13			
11	72084688027	1316795236	1.71E+18	1.73E+18			
12	78244507542	-2962534688	1.83E+19	8.78E+18			
13	80121685892	2152010560	2.62E+19	4.63E+18			
14	92339114636	4010298662	3.45E+18	1.61E+19			
15	97258516151	434873441.2	1.28E+19	1.89E+17			
16	1.24193E+11	-14400401159	2.2E+20	2.07E+20			
17	1.59959E+11	-25481727614	1.23E+20	6.49E+20			
18	1.64039E+11	-13193802599	1.51E+20	1.74E+20			
19	1.72143E+11	-4522376175	7.52E+19	2.05E+19			
20	1.85249E+11	3709846086	6.78E+19	1.38E+19			
21	1.85142E+11	4403339971	4.81E+17	1.94E+19			
22	1.88351E+11	7892199786	1.22E+19	6.23E+19			
23	1.64944E+11	17567704843	9.36E+19	3.09E+20			
24	1.63705E+11	18690142885	1.26E+18	3.49E+20			
25	1.82787E+11	13952202507	2.24E+19	1.95E+20			
26	2.02738E+11	1317814936	1.6E+20	1.74E+18			
27	2.12396E+11	-5477236186	4.62E+19	3E+19			
28	1.79456E+11	-12849757983	5.44E+19	1.65E+20			

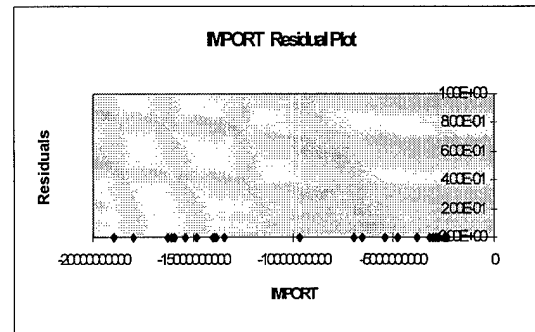
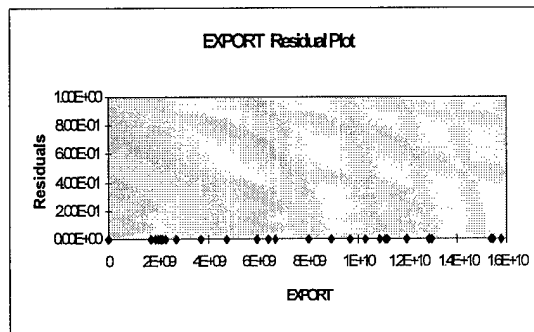
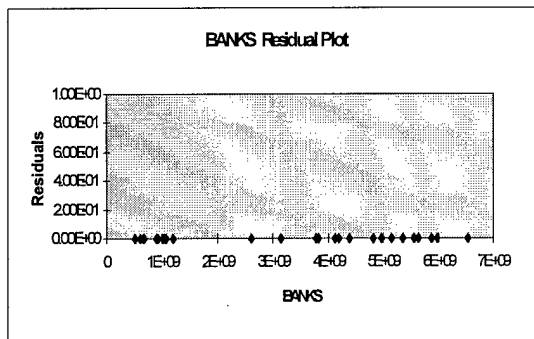


Figure A-9. Residual Plots for India (No Foreign Debt)

Table A-24. Regression Analysis for Iran

SUMMARY OUTPUT								
Regression Statistics								
Multiple R	0.963069922							
R Square	0.927503675							
Adjusted R Squ	0.915420954							
Standard Error	4682446373							
Observations	29							
ANOVA								
	n=29, k=5	99% Confidence Critical F (4,24)			4.22			
	df	SS	MS	F	Significance F			
Regression	4	6.73219E+21	1.68E+21	76.76282	2.55655E-13			
Residual	24	5.26207E+20	2.19E+19					
Total	28	7.2584E+21						
Coefficients								
	Coefficients	Standard Error	t Stat	P-value	Critical t ₉₀	Critical t ₉₅	Critical t ₉₉	
Intercept	3353096421	1274979594	2.629922	0.014675	1.711	2.064	2.797	
BANKS	-0.6294327	0.349991787	-1.79842	0.084701				
FORDEBT	-1.01065618	28.46773002	-0.0355	0.971973				
EXPORT	2.482178235	3.929583135	0.631665	0.533577				
IMPORT	-3.427876828	3.160449355	-1.08462	0.288867				
RESIDUAL OUTPUT								
Observation	Predicted GDP	Residuals	DW test		BANKS	FORDEBT	EXPORT	IMPORT
1	3585348574	-3149348574			BANKS	1		
2	3623705737	-3145705737	1.33E+13	9.9E+18	FORDEBT	-0.664062824	1	
3	3670569452	-3147569452	3.47E+12	9.91E+18	EXPORT	-0.057714709	0.016308025	1
4	3741111431	-3164111431	2.74E+14	1E+19	IMPORT	0.162803419	-0.115712542	-0.98852
5	3864245044	-3240245044	5.8E+15	1.05E+19				
6	3950823590	-3146823590	8.73E+15	9.9E+18	Durbin Watson test for autocorrelation of residuals			
7	4126831939	-3355831939	4.37E+16	1.13E+19				
8	4228580441	-3259580441	9.26E+15	1.06E+19	DW statistic	0.42		
9	4387989237	-3179989237	6.33E+15	1.01E+19	95% Confidenced _L	1.12	d _U 1.74	
10	5479692279	-3715692279	2.87E+17	1.38E+19				
11	5127249308	-2037249308	2.82E+18	4.15E+18				
12	6315957577	-2803957577	5.88E+17	7.86E+18				
13	7506094202	-2809094202	2.64E+13	7.89E+18				
14	6266598980	-318598979.5	6.2E+18	1.02E+17				
15	4033135947	1145864053	2.14E+18	1.31E+18				
16	3428343533	2541656467	1.95E+18	6.46E+18				
17	4277332244	2354667756	3.5E+16	5.54E+18				
18	9112164247	-1103164247	1.2E+19	1.22E+18				
19	8617873131	1922126869	9.15E+18	3.69E+18				
20	14302390760	-926390759.8	8.11E+18	8.58E+17				
21	12690680223	2113319777	9.24E+18	4.47E+18				
22	10725792566	5049207434	8.62E+18	2.55E+19				
23	7853249527	8373750473	1.11E+19	7.01E+19				
24	8593139090	11355860910	8.89E+18	1.29E+20				
25	13041526209	9262473791	4.38E+18	8.58E+19				
26	22461797861	5325202139	1.55E+19	2.84E+19				
27	39931436198	-3286436198	7.42E+19	1.08E+19				
28	55136561881	-5029561881	3.04E+18	2.53E+19				
29	66435778791	1375221209	4.1E+19	1.89E+18				

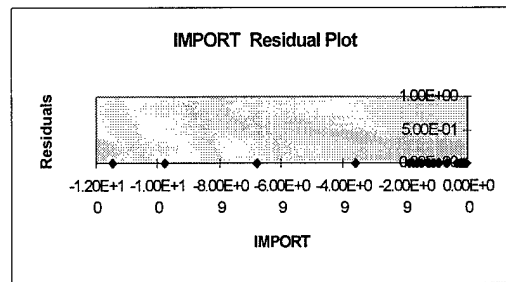
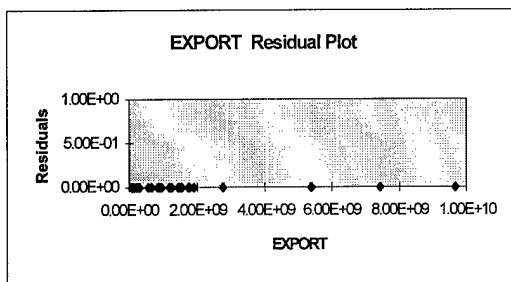
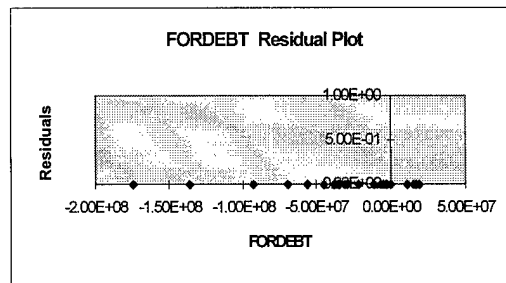
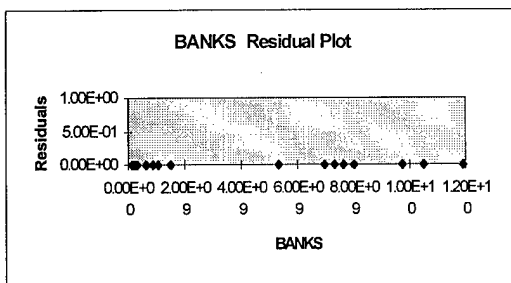


Figure A-10. Residual Plots for Iran

Table A-25. Regression Analysis for Japan

SUMMARY OUTPUT									
Regression Statistics									
Multiple R	0.99565967								
R Square	0.991338179								
Adjusted R Square	0.989952288								
Standard Error	91082740037								
Observations	30								
ANOVA									
	n=30, k=5	99% confidence Critical F (4,25):		4.18					
	df	SS	MS	F	Significance F				
Regression	4	2.37369E+25	5.93E+24	715.3073	2.22306E-25				
Residual	25	2.07402E+23	8.3E+21						
Total	29	2.39443E+25							
	Coefficients	Standard Error	t Stat	P-value	critical t ₉₉	crit t ₉₉	critical t ₉₉		
Intercept	-5.1253E+10	28276250112	-1.81259	0.081922	1.708	2.06	2.787		
BANKS	15.18870224	1.790478627	8.48304	7.94E-09					
FORDEBT	-52.9509558	9.177991004	-5.76934	5.17E-06					
EXPORT	9.371241687	1.056210478	8.872513	3.38E-09					
IMPORT	3.211131271	1.206538336	2.661442	0.013399					
RESIDUAL OUTPUT									
Observation	Predicted GDF	Residuals	DW Test		BANKS	FORDEBT	EXPORT	IMPORT	
1	27101250997	55346418553			BANKS	1			
2	44430018397	46636759104	7.59E+19	2.17E+21	FORDEBT	0.63369483	1		
3	54741793657	50563472986	1.54E+19	2.56E+21	EXPORT	0.901693904	0.611594379	1	
4	53860347694	69736679191	3.68E+20	4.86E+21	IMPORT	-0.876835575	-0.606447518	-0.982172312	1
5	90290962026	57808003587	1.42E+20	3.34E+21					
6	1.26047E+11	47874312583	9.87E+19	2.29E+21					
7	1.6724E+11	37834540441	1.01E+20	1.43E+21	Durbin Watson test for autocorrelation of residuals				
8	3.71479E+11	-1.3536E+11	3E+22	1.83E+22	DW Statistic	1.74			
9	4.10308E+11	-1.28515E+11	4.68E+19	1.65E+22	95% Confidence	d _L 1.14	d _U 1.74		
10	3.10974E+11	22076681756	2.27E+22	4.87E+20					
11	4.16023E+11	-51694708600	5.44E+21	2.67E+21					
12	3.60313E+11	54901010454	1.14E+22	3.01E+21					
13	5.0653E+11	-16868201008	5.15E+21	2.85E+20					
14	6.91863E+11	-55146522649	1.47E+21	3.04E+21					
15	8.44268E+11	-38003754923	2.94E+20	1.44E+21					
16	6.02553E+11	99078340887	1.88E+22	9.82E+21					
17	8.77686E+11	49956560562	2.41E+21	2.5E+21					
18	1.12157E+12	-1.1371E+11	2.68E+22	1.29E+22					
19	1.09395E+12	-50085749240	4.05E+21	2.51E+21					
20	1.21907E+12	-60008438863	9.85E+19	3.6E+21					
21	1.38858E+12	-1.67506E+11	1.16E+22	2.81E+22					
22	1.57649E+12	-1.21559E+11	2.11E+21	1.48E+22					
23	1.86084E+12	1.71894E+11	8.61E+22	2.95E+22					
24	2.04328E+12	-54549774746	5.13E+22	2.98E+21					
25	2.20265E+12	-9514405214	2.03E+21	9.05E+19					
26	2.11308E+12	-11468053761	3.81E+18	1.31E+20					
27	2.04316E+12	1.77105E+11	3.56E+22	3.14E+22					
28	2.52075E+12	-802291573.7	3.17E+22	6.44E+17					
29	2.64645E+12	57737160337	3.43E+21	3.33E+21					
30	3.03504E+12	16241426451	1.72E+21	2.64E+20					

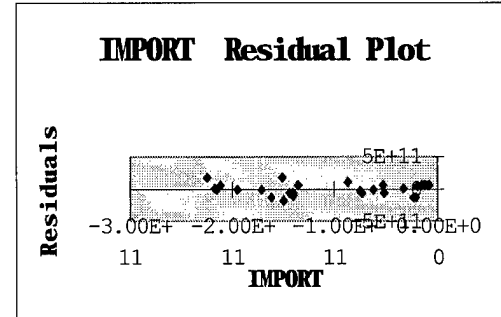
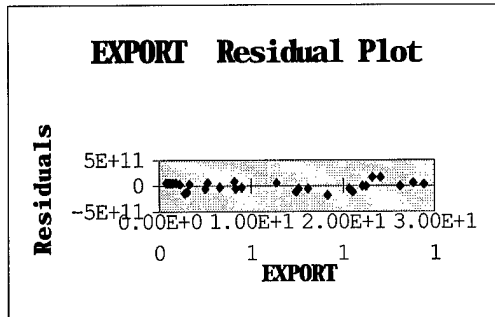
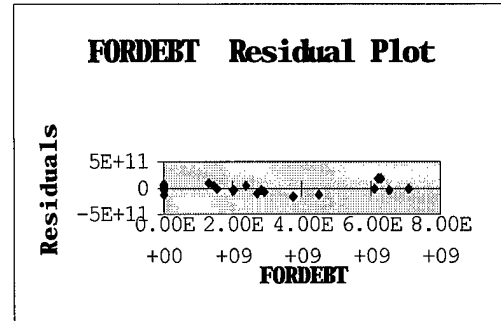
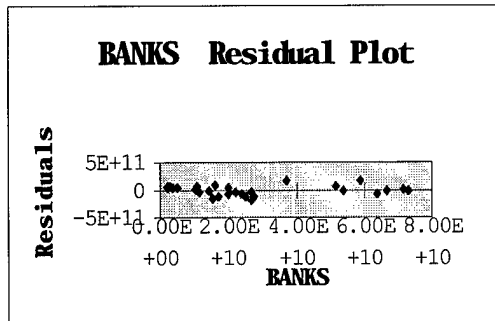


Figure A-11. Residual Plots for Japan

Table A-26. Regression Analysis for Japan (Constant =0)

SUMMARY OUTPUT								
Regression Statistics								
Multiple R	0.995087861							
R Square	0.990199851							
Adjusted R Square	0.950607526							
Standard Error	95001650956							
Observations	30							
99% confidence								
ANOVA	n=30, k=4	Critical F (3,26):		4.64				
	df	SS	MS	F	Significance F			
Regression	4	2.37097E+25	5.93E+24	656.7552	6.3983E-25			
Residual	26	2.34658E+23	9.03E+21					
Total	30	2.39443E+25						
	Coefficients	Standard Error	t Stat	P-value	critical t ₉₀	crit t ₉₅	critical t ₉₉	
Intercept	0				1.706	2.056	2.779	
BANKS	14.96880686	1.863223766	8.033821	1.63E-08				
FORDEBT	-53.31705033	9.570563489	-5.57094	7.5E-06				
EXPORT	9.724870176	1.082698076	8.98207	1.89E-09				
IMPORT	3.907035427	1.193038134	3.274862	0.002991				
RESIDUAL OUTPUT								
Observation	Predicted GDP	Residuals	DW Test		BANKS	FORDEBT	EXPORT	IMPORT
1	75134482067	7313187483			BANKS	1		
2	92824077737	-1757300237	8.23E+19	3.09E+18	FORDEBT	0.63369483	1	
3	1.02869E+11	2436703496	1.76E+19	5.94E+18	EXPORT	0.901693904	0.611594379	1
4	1.00782E+11	22814928796	4.15E+20	5.21E+20	IMPORT	-0.876835575	-0.606447518	-0.982172312
5	1.36938E+11	11161429537	1.36E+20	1.25E+20				
6	1.72151E+11	1770630376	8.82E+19	3.14E+18				
7	2.11675E+11	-6599821124	7.01E+19	4.36E+19	Durbin Watson test for autocorrelation of residuals			
8	4.14387E+11	-1.78268E+11	2.95E+22	3.18E+22	DW Statistic	1.52		
9	4.52162E+11	-1.7037E+11	6.24E+19	2.9E+22	95% Confidenced _u 1.14	du 1.74		
10	3.48589E+11	-15538135744	2.4E+22	2.41E+20				
11	4.45957E+11	-81629159114	4.37E+21	6.66E+21				
12	3.90651E+11	24563134121	1.13E+22	6.03E+20				
13	5.34062E+11	-44400523796	4.76E+21	1.97E+21				
14	7.16718E+11	-80001504211	1.27E+21	6.4E+21				
15	8.67961E+11	-61697235798	3.35E+20	3.81E+21				
16	6.17629E+11	84002114379	2.12E+22	7.06E+21				
17	8.74464E+11	53178965621	9.5E+20	2.83E+21				
18	1.12118E+12	-1.13319E+11	2.77E+22	1.28E+22				
19	1.09282E+12	-48960156225	4.14E+21	2.4E+21				
20	1.22308E+12	-64022169878	2.27E+20	4.1E+21				
21	1.39312E+12	-1.7205E+11	1.17E+22	2.96E+22				
22	1.58218E+12	-1.27255E+11	2.01E+21	1.62E+22				
23	1.8787E+12	1.54038E+11	7.91E+22	2.37E+22				
24	2.05118E+12	-62449535394	4.69E+22	3.9E+21				
25	2.19413E+12	-996649469.8	3.78E+21	9.93E+17				
26	2.09123E+12	10387337359	1.3E+20	1.08E+20				
27	2.00812E+12	2.12147E+11	4.07E+22	4.5E+22				
28	2.50294E+12	17005538763	3.81E+22	2.89E+20				
29	2.63728E+12	66909552648	2.49E+21	4.48E+21				
30	3.0215E+12	29784108317	1.38E+21	8.87E+20				

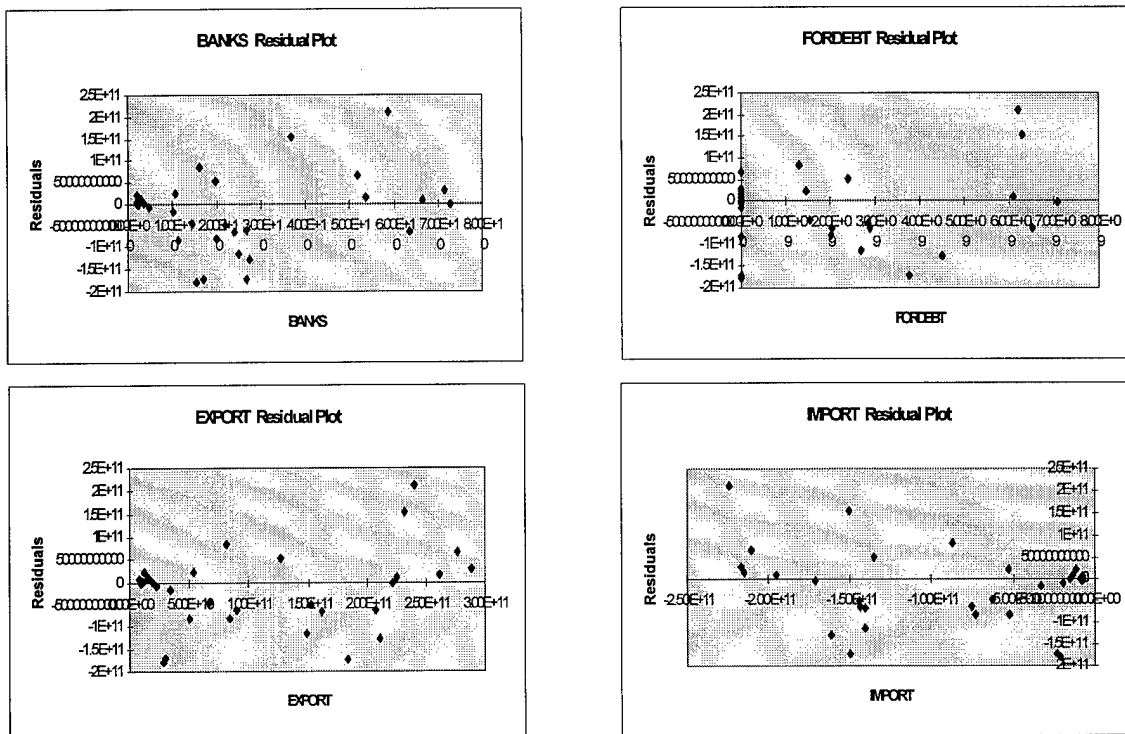


Figure A-12. Residual Plots for Japan (Constant = 0)

Table A-27. Regression Analysis for Korea

SUMMARY OUTPUT							
Regression Statistics							
Multiple R	0.985008236						
R Square	0.970241225						
Adjusted R Square	0.965479821						
Standard Error	13278503122						
Observations	30						
ANOVA							
	n=30 k=5	99% confidence					
		Critical F (4,25)	4.18				
	df	SS	MS	F	Significance F		
Regression	4	1.43715E+23	3.59E+22	203.7721	1.09241E-18		
Residual	25	4.40797E+21	1.76E+20				
Total	29	1.48123E+23					
Coefficients							
		Standard Error	t Stat	P-value	critical t ₉₀	critical t ₉₅	critical t ₉₉
Intercept	1393275452	3980403275	0.350034	0.729245	1.708	2.06	2.787
BANKS	9.2183274	1.959930284	4.703396	8.04E-05			
FORDEBT	1.284119331	1.449487727	0.885913	0.384107			
EXPORT	1.418547608	0.449979178	3.152474	0.004174			
IMPORT	2.63642E-13	3.67948E-12	0.071652	0.943449			
RESIDUAL OUTPUT							
Observation	Predicted GDP	Residuals	DW Test	BANKS			
1	2880462346	-100230106		BANKS	1		
2	3097206908	-160640567.3	3.65E+15	2.58E+16	FORDEBT	0.222879	1
3	4211484649	-435394967.2	7.55E+16	1.9E+17	EXPORT	0.921918	0.481393
4	5424051002	-839200309.8	1.63E+17	7.04E+17	IMPORT	0.502221	-0.20897
5	6050843775	-260435249.6	3.35E+17	6.78E+16			0.432493
6	7832911346	-836688649.5	3.32E+17	7E+17			
7	9530716382	-928158352.8	8.37E+15	8.61E+17			
8	8223489237	113545058.4	1.09E+18	1.29E+16	DW Statistic	1.30	
9	9902471149	-273987462.1	1.5E+17	7.51E+16	d		

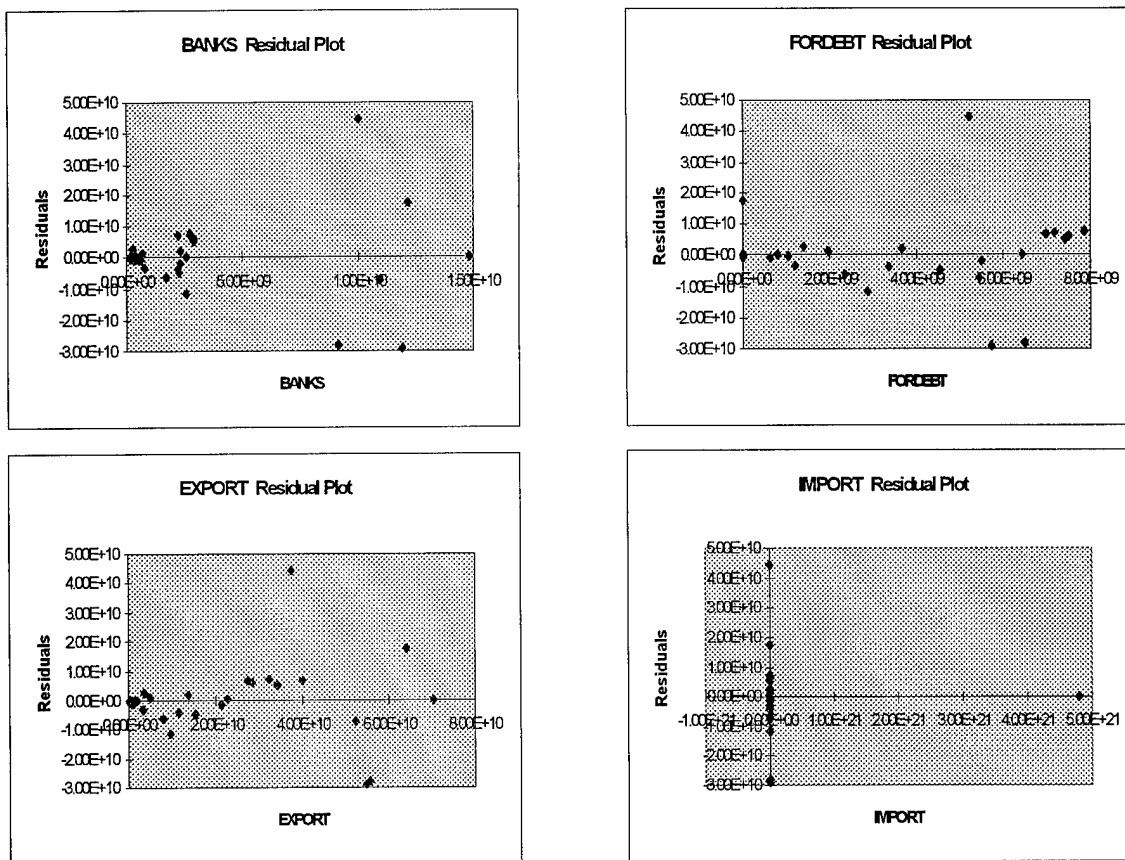


Figure A-13. Residual Plots for Korea

Table A-28. Regression Analysis for Libya

SUMMARY OUTPUT								
Regression Statistics								
Multiple R	0.985008236							
R Square	0.970241225							
Adjusted R Square	0.965479821							
Standard Error	13278503122							
Observations	30							
		99% confidence						
ANOVA	n=30 k=5	Critical F (4,25)	4.18					
	df	SS	MS	F	Significance F			
Regression	4	1.43715E+23	3.59E+22	203.7721	1.09241E-18			
Residual	25	4.40797E+21	1.76E+20					
Total	29	1.48123E+23						
	Coefficients	Standard Error	t Stat	P-value	critical t ₉₀	critical t ₉₅	critical t ₉₉	
Intercept	1393275452	3980403275	0.350034	0.729245	1.708	2.06	2.787	
BANKS	9.2183274	1.959930284	4.703396	8.04E-05				
FORDEBT	1.284119331	1.449487727	0.885913	0.384107				
EXPORT	1.418547608	0.449979178	3.152474	0.004174				
IMPORT	2.63642E-13	3.67948E-12	0.071652	0.943449				
RESIDUAL OUTPUT								
Observation	Predicted GDP	Residuals	DW Test		BANKS	FORDEBT	EXPORT	IMPORT
1	2880462346	-100230106			BANKS	1		
2	3097206908	-160640567.3	3.65E+15	2.58E+16	FORDEBT	0.222879	1	
3	4211484649	-435394967.2	7.55E+16	1.9E+17	EXPORT	0.921918	0.481393	1
4	5424051002	-839200309.8	1.63E+17	7.04E+17	IMPORT	0.502221	-0.20897	0.432493
5	6050843775	-260435249.6	3.35E+17	6.78E+16				
6	7832911346	-836688649.5	3.32E+17	7E+17				
7	9530716382	-928158352.8	8.37E+15	8.61E+17	Durbin Watson test for autocorrelation of residuals			
8	8223489237	113545058.4	1.09E+18	1.29E+16	DW Statistic	1.30		
9	9902471149	-273987462.1	1.5E+17	7.51E+16	95% Confidence d _L	1.14	d _U 1.74	
10	14489117597	-3194489636	8.53E+18	1.02E+19				
11	10313222945	2459520436	3.2E+19	6.05E+18				
12	17049072403	1030701688	2.04E+18	1.06E+18				
13	31379273686	-6489973809	5.66E+19	4.21E+19				
14	42339602189	-11597324329	2.61E+19	1.34E+20				
15	42539097209	-3958492974	5.84E+19	1.57E+19				
16	46896656763	2230525282	3.83E+19	4.98E+18				
17	49970453979	-4771794219	4.9E+19	2.28E+19				
18	59859031272	-1623917517	9.91E+18	2.64E+18				
19	65600195982	310628342.4	3.74E+18	9.65E+16				
20	69852797545	6791256006	4.2E+19	4.61E+19				
21	82226820870	7343232026	3.05E+17	5.39E+19				
22	77922741052	6001538716	1.8E+18	3.6E+19				
23	85763001789	5097427572	8.17E+17	2.6E+19				
24	92994834824	6764951653	2.78E+18	4.58E+19				
25	1.72727E+11	-28109246583	1.22E+21	7.9E+20				
26	1.95935E+11	-28915836906	6.51E+17	8.36E+20				
27	1.83537E+11	-7378468047	4.64E+20	5.44E+19				
28	1.53744E+11	44492161954	2.69E+21	1.98E+21				
29	2.04515E+11	17238790950	7.43E+20	2.97E+20				
30	2.39239E+11	0.294342041	2.97E+20	0.086637				

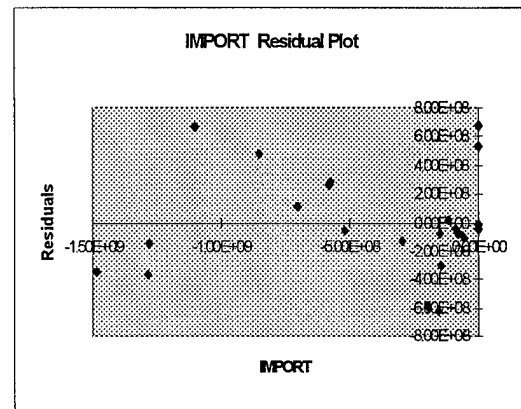
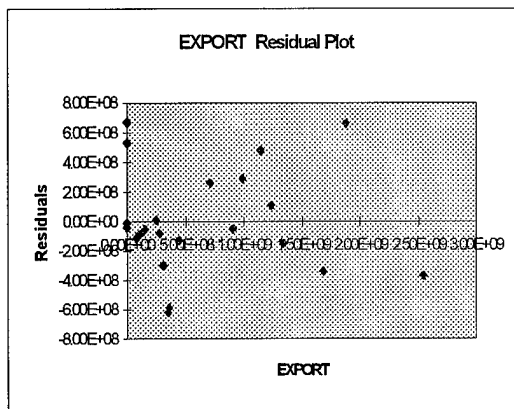
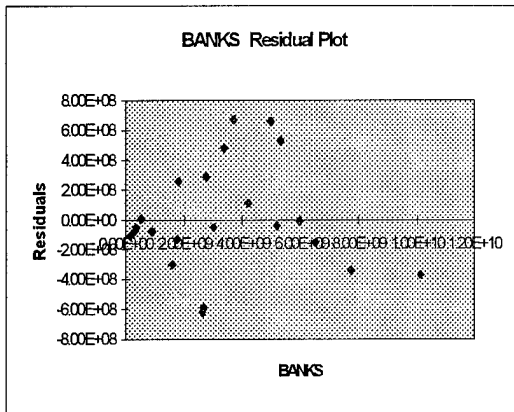


Figure A-14. Residual Plots for Libya

Table A-29. Regression Analysis for Mexico

SUMMARY OUTPUT								
Regression Statistics								
Multiple R	0.99611911							
R Square	0.992253281							
Adjusted R Square	0.990962161							
Standard Error	16259869562							
Observations	29							
99% confidence								
ANOVA	n=29 k=4	Critical F (3,25) 4.68						
	df	SS	MS	F	Significance F			
Regression	4	8.12737E+23	2.03E+23	768.5215	6.02893E-25			
Residual	24	6.3452E+21	2.64E+20					
Total	28	8.19082E+23						
	Coefficients	Standard Error	t Stat	P-value	critical t ₉₀	critical t ₉₅	critical t ₉₉	
Intercept	19904815640	5152156427	3.863395	0.000744	1.708	2.06	2.787	
BANKS	2.959425861	1.517607911	1.95006	0.062944				
FORDEBT	1.198098395	2.362172043	0.507202	0.616642				
EXPORT	1.61246E-10	7.9564E-11	2.026625	0.053951				
IMPORT	-5.189266412	0.172327937	-30.1127	1.41E-20				
RESIDUAL OUTPUT								
Observation	Predicted GDP	Residuals	DW Test		BANKS	FORDEBT	EXPORT	IMPORT
1	31771446656	-14059446656			BANKS	1		
2	32332629935	-12172629935	3.56E+18	1.48E+20	FORDEBT	-0.32993	1	
3	33098505998	-10474505998	2.88E+18	1.1E+20	EXPORT	0.041706	-0.09760092	1
4	34261251716	-9757251716	5.14E+17	9.52E+19	IMPORT	-0.81602	0.205470418	-0.052527582
5	36885660211	-9757660211	1.67E+11	9.52E+19				
6	38413237002	-8421237002	1.79E+18	7.09E+19				
7	41093202671	-5549202671	8.25E+18	3.08E+19	Durbin Watson test for autocorrelation of residuals			
8	40071088148	-4034323442	2.29E+18	1.63E+19	DW Statistic	0.90		
9	43306715928	-1784657104	5.06E+18	3.19E+18	95% Confidences	du 1.14	du 1.74	
10	48095775679	-2340808791	3.09E+17	5.48E+18				
11	58786729702	17191866.49	5.56E+18	2.96E+14				
12	68665558926	6683756143	4.44E+19	4.47E+19				
13	58413429083	681398503.4	3.6E+19	4.64E+17				
14	60327181336	6665572287	3.58E+19	4.44E+19				
15	70451676953	8501025750	3.37E+18	7.23E+19				
16	88643125437	13623541229	2.62E+19	1.86E+20				
17	1.29912E+11	20593079725	4.86E+19	4.24E+20				
18	2.00918E+11	-9.297058105	4.24E+20	86.43529				
19	73662462170	18339417529	3.36E+20	3.36E+20				
20	91025688690	27613992796	8.6E+19	7.63E+20				
21	1.20361E+11	35823758946	6.74E+19	1.28E+21				
22	96443118997	19628397045	2.62E+20	3.85E+20				
23	83082003710	-12976656684	1.06E+21	1.68E+20				
24	91266397588	-29599943587	2.76E+20	8.76E+20				
25	1.32213E+11	-5009436545	6.05E+20	2.51E+19				
26	1.57188E+11	-10929884359	3.51E+19	1.19E+20				
27	1.85466E+11	-21657661303	1.15E+20	4.69E+20				
28	6.07249E+11	13876731385	1.26E+21	1.93E+20				
29	8.07443E+11	-13522557190	7.51E+20	1.83E+20				

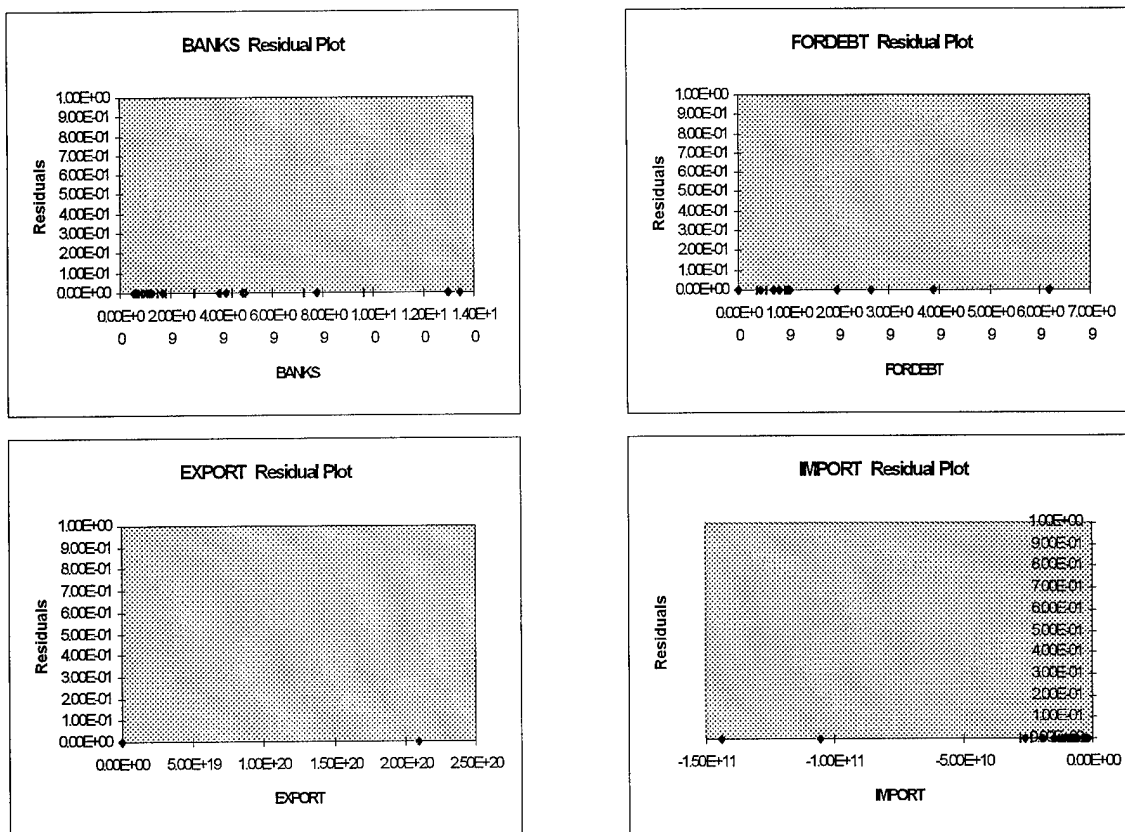


Figure A-15. Residual Plots for Mexico

Table A-30. Regression Analysis for Mexico (No foreign Debt)

SUMMARY OUTPUT							
<i>Regression Statistics</i>							
Multiple R	0.996077429						
R Square	0.992170245						
Adjusted R Square	0.991230674						
Standard Error	16016509281						
Observations	29						
		99% confidence					
ANOVA	n=29 k=4	Critical F (3,25)		4.68			
	df	SS	MS	F	Significance F		
Regression	3	8.12669E+23	2.71E+23	1055.983	1.92253E-26		
Residual	25	6.41321E+21	2.57E+20				
Total	28	8.19082E+23					
	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>critical t₉₀</i>	<i>critical t₉₅</i>	<i>critical t₉₉</i>
Intercept	21345909579	4233573635	5.042055	3.34E-05	1.708	2.06	2.787
BANKS	2.737618515	1.43148348	1.912435	0.067344			
EXPORT	1.5748E-10	7.80311E-11	2.018174	0.054425			
IMPORT	-5.199775865	0.168517197	-30.8561	2.01E-21			
RESIDUAL OUTPUT							
<i>Observation</i>	<i>Predicted GDP</i>	<i>Residuals</i>	<i>DW Test</i>			<i>BANKS</i>	<i>EXPORT</i>
1	33102854136	-15390854136			BANKS	1	
2	33215562452	-13055562452	5.45E+18	1.7E+20	EXPORT	0.041706	1
3	33913451256	-11289451256	3.12E+18	1.27E+20	IMPORT	-0.81602	-0.05253
4	34930437622	-10426437622	7.45E+17	1.09E+20			
5	37371111711	-10243111711	3.36E+16	1.05E+20	Durbin Watson test for autocorrelation of residuals		
6	38757540632	-8765540632	2.18E+18	7.68E+19	DW Statistic	0.59	
7	41228328523	-5684328523	9.49E+18	3.23E+19	95% Confidence	1.20	1.65
8	40226423140	-4189658434	2.23E+18	1.76E+19			
9	43321319158	-1799260335	5.71E+18	3.24E+18			
10	46978506145	-1223539257	3.31E+17	1.5E+18			
11	56871118739	1932802829	9.96E+18	3.74E+18			
12	62494157331	12855157738	1.19E+20	1.65E+20			
13	54985484598	4109342988	7.65E+19	1.69E+19			
14	61473951334	5518802289	1.99E+18	3.05E+19			
15	71585935280	7366767423	3.41E+18	5.43E+19			
16	90018550471	12248116195	2.38E+19	1.5E+20			
17	1.30909E+11	19596408463	5.4E+19	3.84E+20			
18	2.00918E+11	-8.970031738	3.84E+20	80.46147			
19	74869900996	17131978703	2.94E+20	2.94E+20			
20	91599885771	27039795716	9.82E+19	7.31E+20			
21	1.20231E+11	35952954204	7.94E+19	1.29E+21			
22	96938470973	19133045069	2.83E+20	3.66E+20			
23	83550099042	-13444752016	1.06E+21	1.81E+20			
24	90656276207	-28989822206	2.42E+20	8.4E+20			
25	1.32987E+11	-5783151013	5.39E+20	3.34E+19			
26	1.57782E+11	-11524221413	3.3E+19	1.33E+20			
27	1.85586E+11	-21778099403	1.05E+20	4.74E+20			
28	6.06928E+11	14197452521	1.29E+21	2.02E+20			
29	8.07416E+11	-13494833721	7.67E+20	1.82E+20			

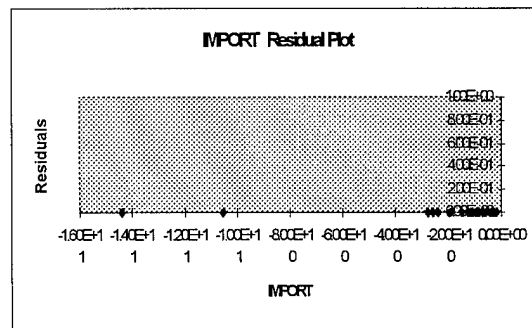
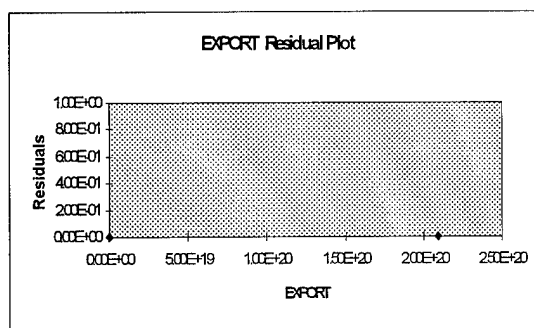
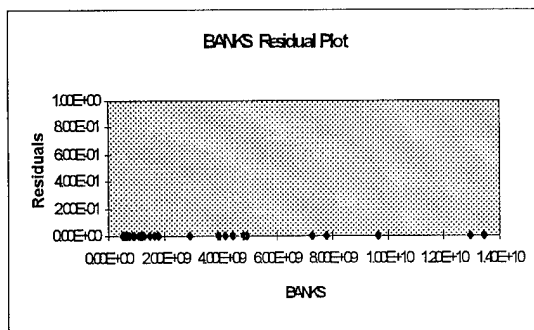


Figure A-16. Residual Plots for Mexico (No foreign Debt)

Table A-31. Regression Analysis of Nigeria

SUMMARY OUTPUT									
Regression Statistics									
Multiple R	0.990168127								
R Square	0.98043292								
Adjusted R Square	0.977302187								
Standard Error	1946638532								
Observations	30								
		99% Confidence							
ANOVA	n=30, k=5	Critical F (4,25)	4.18						
	df	SS	MS	F	Significance F				
Regression	4	4.74682E+21	1.19E+21	313.164	5.84075E-21				
Residual	25	9.4735E+19	3.79E+18						
Total	29	4.84155E+21							
	Coefficients	Standard Error	t Stat	P-value	Critical t ₉₀	Critical t ₉₅	Critical t ₉₉		
Intercept	1063951792	560066613.6	1.899688	0.069069	1.703	2.052	2.771		
BANKS	-0.684585801	1.905435486	-0.35928	0.722402					
FORDEBT	0.303934544	0.254998686	1.191906	0.24449					
EXPORT	0.235799088	0.516847711	0.456225	0.652167					
IMPORT	-3.885444066	0.727618969	-5.33994	1.55E-05					
RESIDUAL OUTPUT									
Observation	Predicted GDP	Residuals	DW test			BANKS	FORDEBT	EXPORT	IMPORT
1	1287312721	-972812720.6			BANKS	1			
2	1311830521	-975730521.2	8.51E+12	9.52E+17	FORDEBT	0.100056028	1		
3	1311637439	-950237438.8	6.5E+14	9.03E+17	EXPORT	-0.004679639	0.383947363	1	
4	1309855640	-1014755640	4.16E+15	1.03E+18	IMPORT	0.037613882	-0.231998342	-0.97387	
5	1300549604	-1012749604	4.02E+12	1.03E+18					
6	1366938323	-981838323.2	9.56E+14	9.64E+17	Durbin Watson test for autocorrelation of residuals				
7	1465799964	-903699964.3	6.11E+15	8.17E+17					
8	1608886908	-901209939	6.2E+12	8.12E+17	DW statistic	1.08			
9	1562480181	-852984003.5	2.33E+15	7.28E+17	95% Confidence d _L 1.14	d _U 1.74			
10	1680511987	-741077376.2	1.25E+16	5.49E+17					
11	1832086355	-267892109.4	2.24E+17	7.18E+16					
12	2485735321	-692044002	1.8E+17	4.79E+17					
13	3140034919	-751814910.1	3.57E+15	5.65E+17					
14	3878608353	-1073726126	1.04E+17	1.15E+18					
15	4344862927	-1462754301	1.51E+17	2.14E+18					
16	3617456829	-277596148.3	1.4E+18	7.71E+16					
17	1456311479	2450642036	7.44E+18	6.01E+18					
18	5810496871	-1506816410	1.57E+19	2.27E+18					
19	2168548585	2515237647	1.62E+19	6.33E+18					
20	4440133510	905235994.1	2.59E+18	8.19E+17					
21	2180375907	4025282630	9.73E+18	1.62E+19					
22	4464946166	2661518918	1.86E+18	7.08E+18					
23	4520788563	1706794117	9.11E+17	2.91E+18					
24	7358970078	1061492377	4.16E+17	1.13E+18					
25	7983338342	2824236626	3.11E+18	7.98E+18					
26	15432799267	2104804104	5.18E+17	4.43E+18					
27	21702473874	-2492789322	2.11E+19	6.21E+18					
28	27359269723	-3677717318	1.4E+18	1.35E+19					
29	40356792733	-1081444820	6.74E+18	1.17E+18					
30	56527694394	2336446550	1.17E+19	5.46E+18					

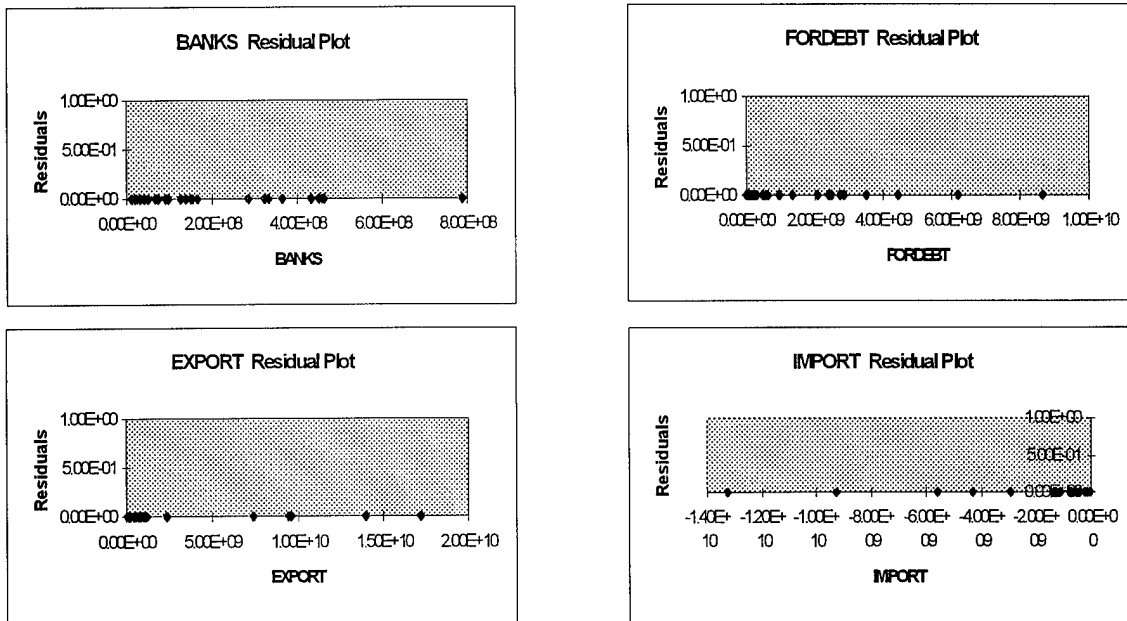


Figure A-17. Residual Plots of Nigeria

Table A-32. Regression Analysis of South Africa

SUMMARY OUTPUT								
Regression Statistics								
Multiple R	0.915212646							
R Square	0.837614188							
Adjusted R Square	0.811632458							
Standard Error	1.99807E+11							
Observations	30							
ANOVA								
	n=30, k=5	99% confidence						
		Critical F (4,25):		4.18				
	df	SS	MS	F	Significance F			
Regression	4	5.14821E+24	1.29E+24	32.23858	1.55389E-09			
Residual	25	9.98068E+23	3.99E+22					
Total	29	6.14628E+24						
	Coefficients	Standard Error	t Stat	P-value	critical t ₉₀	crit t ₉₅	critical t ₉₉	
Intercept	49383009167	81817417101	0.603576	0.551563	1.708	2.06	2.787	
BANKS	-282.7533457	45.02712505	-6.27962	1.43E-06				
FORDEBT	-333.8579539	74.79755183	-4.46349	0.00015				
EXPORT	93.54305446	22.30918064	4.19303	0.000301				
IMPORT	10.91822598	28.13893895	0.388011	0.701292				
RESIDUAL OUTPUT								
Observation	Predicted GDP	Residuals	DW Test		BANKS	FORDEBT	EXPORT	IMPORT
1	17892984308	-8096494148			BANKS	1		
2	36205737265	-30717614386	5.12E+20	9.44E+20	FORDEBT	0.371871	1	
3	12682031632	-6678801773	5.78E+20	4.46E+19	EXPORT	0.690228	0.404345	1
4	61397472528	-54723671922	2.31E+21	2.99E+21	IMPORT	-0.68362	-0.4465	-0.96856
5	-1.05032E+11	1.12318E+11	2.79E+22	1.26E+22				
6	-87599164918	95745724346	2.75E+20	9.17E+21				
7	-44870528571	53816556902	1.76E+21	2.9E+21	Durbin Watson test for autocorrelation of residuals			
8	-31937989117	43376269594	1.09E+20	1.88E+21	DW Statistic	0.89		
9	-1.04692E+11	1.17897E+11	5.55E+21	1.39E+22	95% Confidence d _L	1.14	d _U 1.74	
10	92482410728	-76922411052	3.8E+22	5.92E+21				
11	2.19777E+11	-1.99775E+11	1.51E+22	3.99E+22				
12	94189722335	-67064970465	1.76E+22	4.5E+21				
13	87612585954	-57283839313	9.57E+19	3.28E+21				
14	2.61648E+11	-2.26514E+11	2.86E+22	5.13E+22				
15	1.12549E+11	-69220492659	2.47E+22	4.79E+21				
16	-21325111466	71181876201	1.97E+22	5.07E+21				
17	2.25899E+11	-1.68548E+11	5.75E+22	2.84E+22				
18	3.35441E+11	-2.563E+11	7.7E+21	6.57E+22				
19	-28133991137	1.23747E+11	1.44E+23	1.53E+22				
20	42676283878	74321285522	2.44E+21	5.52E+21				
21	-27240874672	2.35854E+11	2.61E+22	5.56E+22				
22	2.00509E+11	1.45379E+11	8.19E+21	2.11E+22				
23	5.64086E+11	-1.84483E+11	1.09E+23	3.4E+22				
24	5.98136E+11	-1.47681E+11	1.35E+21	2.18E+22				
25	8.94441E+11	-2.607E+11	1.28E+22	6.8E+22				
26	1.0611E+12	-2.83137E+11	5.03E+20	8.02E+22				
27	1.0178E+12	-54609862850	5.22E+22	2.98E+21				
28	8.62404E+11	3.06454E+11	1.3E+23	9.39E+22				
29	8.31953E+11	5.41013E+11	5.5E+22	2.93E+23				
30	1.4731E+12	2.31353E+11	9.59E+22	5.35E+22				

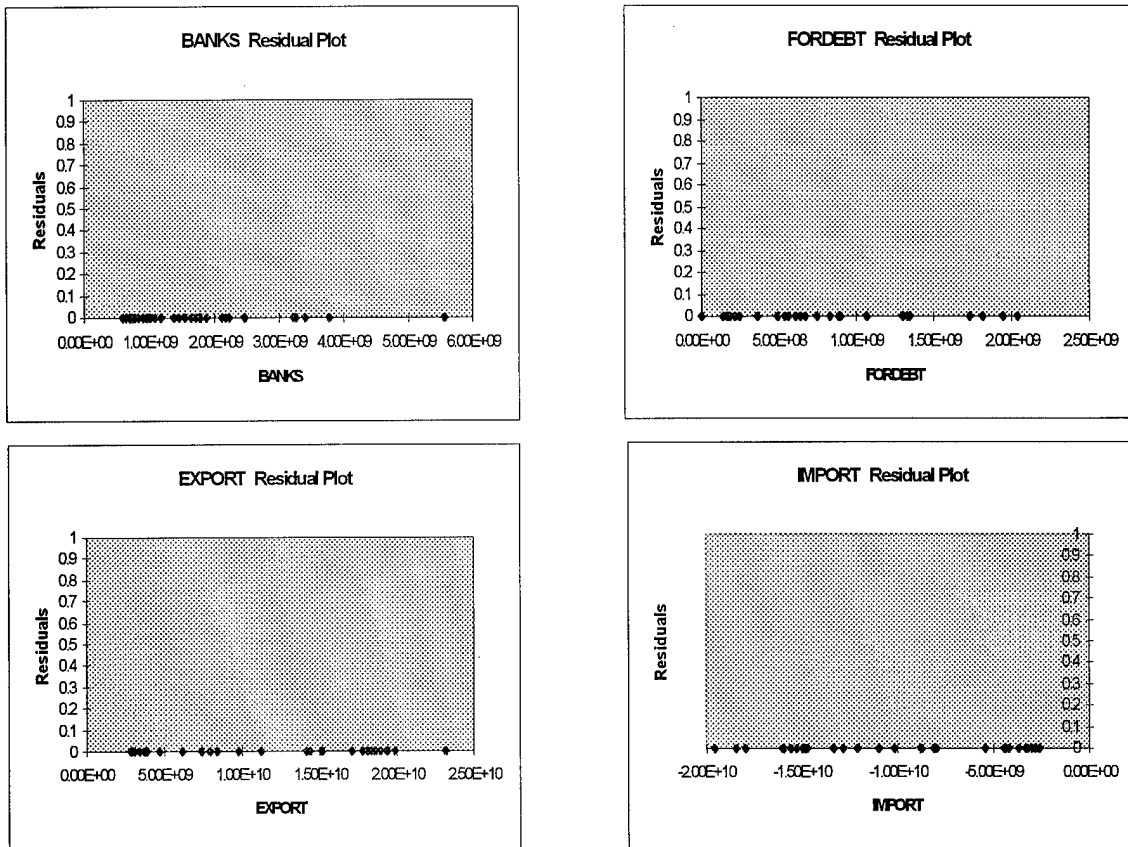


Figure A-18. Residual Plots of South Africa

Table A-33. Regression Analysis of Singapore

SUMMARY OUTPUT							
<i>Regression Statistics</i>							
Multiple R	0.988161583						
R Square	0.976463314						
Adjusted R Square	0.973747542						
Standard Error	1783019922						
Observations	30						
99% confidence							
ANOVA	n=30, k=4	Critical F (3,26):		4.64			
	df	SS	MS	F	Significance F		
Regression	3	3.42923E+21	1.14E+21	359.5528	2.81535E-21		
Residual	26	8.26582E+19	3.18E+18				
Total	29	3.51189E+21					
	Coefficients	Standard Error	t Stat	P-value	critical t ₉₀	crit t ₉₅	critical t ₉₉
Intercept	523727577.1	896271067.7	0.584341	0.564028	1.706	2.056	2.779
BANKS	1.282394766	0.062721245	20.44594	1.52E-17			
FORDEBT	3.414438846	2.789860318	1.223874	0.231975			
EXPORT (net)	-0.479316729	0.578149472	-0.82905	0.414621			
RESIDUAL OUTPUT							
Observation	Predicted GDP	Residuals	DW Test		BANKS	FORDEBT	EXPORT (net)
1	1690127842	-805763021.6		BANKS	1		
2	1704457432	-738444360.1	4.53E+15	5.45E+17	FORDEBT	-0.57087	1
3	1847640458	-766146951.4	7.67E+14	5.87E+17	EXPORT (net)	0.803808	-0.61129
4	2348019963	-1127824523	1.31E+17	1.27E+18			
5	3295741463	-1894767437	5.88E+17	3.59E+18			
6	3603849860	-1979254391	7.14E+15	3.92E+18	Durbin Watson test for autocorrelation of residuals		
7	2225598014	-340857754	2.68E+18	1.16E+17	DW Statistic	0.77	
8	2892396950	-725402095.4	1.48E+17	5.26E+17	95% Confidence d _L 1.21	d _U 1.65	
9	3309329823	-645450279.3	6.39E+15	4.17E+17			
10	3698002971	-295315498	1.23E+17	8.72E+16			
11	4515543426	-84483970.41	4.44E+16	7.14E+15			
12	4590821795	-2227229.724	6.77E+15	4.96E+12			
13	5319961489	-184485306.7	3.32E+16	3.4E+16			
14	6043369157	-397026834.5	4.52E+16	1.58E+17			
15	7342589475	-1016753954	3.84E+17	1.03E+18			
16	7712521104	-496530105.1	2.71E+17	2.47E+17			
17	8578824866	818201463	1.73E+18	6.69E+17			
18	10336839265	1971853469	1.33E+18	3.89E+18			
19	11946663152	2099512522	1.63E+16	4.41E+18			
20	13243689006	3251438750	1.33E+18	1.06E+19			
21	14820828897	3937895165	4.71E+17	1.55E+19			
22	17819223175	-985039280.6	2.42E+19	9.7E+17			
23	15072484706	-539331796.4	1.99E+17	2.91E+17			
24	15875543445	-837450894.6	8.89E+16	7.01E+17			
25	16584943336	2505549219	1.12E+19	6.28E+18			
26	19958823541	3122919781	3.81E+17	9.75E+18			
27	26046969109	616742712.7	6.28E+18	3.8E+17			
28	31163571925	152296531.3	2.16E+17	2.32E+16			
29	35631927442	-665751556.9	6.69E+17	4.43E+17			
30	44246467927	-3948102373	1.08E+19	1.56E+19			

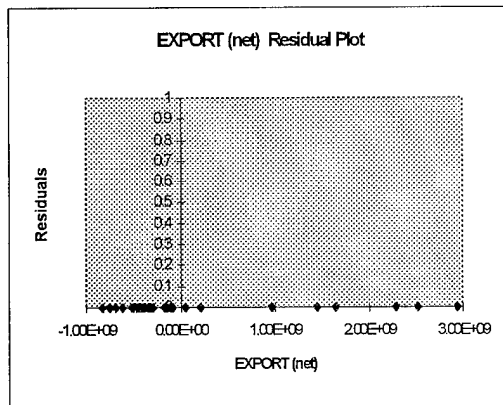
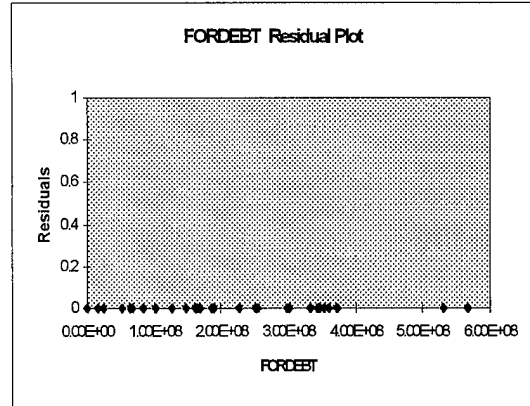
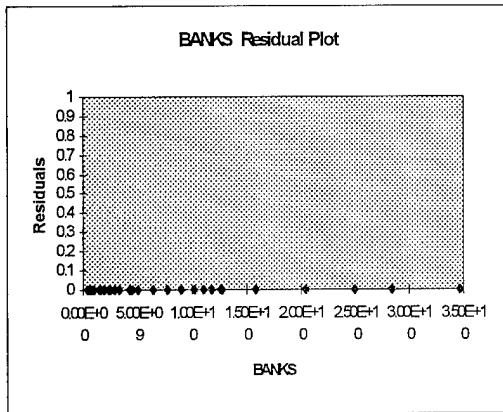


Figure A-19. Residual Plots for Singapore

Table A-34. Regression Analysis of USA

SUMMARY OUTPUT								
Regression Statistics								
Multiple R	0.998689269							
R Square	0.997380257							
Adjusted R Square	0.996961098							
Standard Error	1.01445E+11							
Observations	30							
		99% Confidence						
ANOVA	n=30, k=5	Critical F (4,25)			4.18			
	df	SS	MS	F	Significance F			
Regression	4	9.79493E+25	2.45E+25	2379.48	7.203E-32			
Residual	25	2.57276E+23	1.03E+22					
Total	29	9.82066E+25						
	Coefficients	Standard Error	t Stat	P-value	Critical t ₉₉	Critical t ₉₅	Critical t ₉₀	
Intercept	5.11889E+11	34778672824	14.71846	8.04E-14	1.708	2.06	2.787	
BANKS	1.176773227	2.957466194	0.397899	0.694082				
FORDEBT	0.179862907	0.244482175	0.735689	0.468767				
EXPORT	0.106682838	0.6275461	0.17	0.866378				
IMPORT	-7.828457719	0.521258896	-15.0184	5.1E-14				
RESIDUAL OUTPUT								
Observation	Predicted GDP	Residuals	DW test		BANKS	FORDEBT	EXPORT	IMPORT
1	7.57426E+11	-1.09326E+11						
2	7.82793E+11	-80092762123	8.55E+20	6.41E+21	BANKS	1		
3	8.2595E+11	-56149724434	5.73E+20	3.15E+21	FORDEBT	0.855735958	1	
4	8.48444E+11	-34144318302	4.84E+20	1.17E+21	EXPORT	0.955028193	0.84654409	1
5	9.02263E+11	-12962895634	4.49E+20	1.68E+20	IMPORT	-0.949047174	-0.8535079	-0.98641
6	9.34314E+11	25186133480	1.46E+21	6.34E+20	Durbin Watson test for autocorrelation of residuals			
7	9.75398E+11	35001535994	9.63E+19	1.23E+21				
8	1.0295E+12	67299780237	1.04E+21	4.53E+21	DW statistic	1.36		
9	1.1251E+12	81400297371	1.99E+20	6.63E+21	95% Confidence d _L	1.14	d _U 1.74	
10	1.2624E+12	86702031842	2.81E+19	7.52E+21				
11	1.55254E+12	-94540773359	3.28E+22	8.94E+21				
12	1.51804E+12	66758814627	2.6E+22	4.46E+21				
13	1.74755E+12	19551687616	2.23E+21	3.82E+20				
14	1.99996E+12	-25859873669	2.06E+21	6.69E+20				
15	2.23962E+12	-6921131446	3.59E+20	4.79E+19				
16	2.55826E+12	-69563145465	3.92E+21	4.84E+21				
17	2.89728E+12	-1.89177E+11	1.43E+22	3.58E+22				
18	3.09127E+12	-60669400952	1.65E+22	3.68E+21				
19	2.98248E+12	1.67122E+11	5.19E+22	2.79E+22				
20	3.17955E+12	2.25548E+11	3.41E+21	5.09E+22				
21	3.79361E+12	-16407980983	5.85E+22	2.69E+20				
22	3.90474E+12	1.33958E+11	2.26E+22	1.79E+22				
23	4.18652E+12	82082687784	2.69E+21	6.74E+21				
24	4.62833E+12	-88433229081	2.91E+22	7.82E+21				
25	5.00355E+12	-1.03148E+11	2.17E+20	1.06E+22				
26	5.32534E+12	-74535309502	8.19E+20	5.56E+21				
27	5.64504E+12	-1.2284E+11	2.33E+21	1.51E+22				
28	5.61821E+12	1.04689E+11	5.18E+22	1.1E+22				
29	6.00888E+12	29621610786	5.64E+21	8.77E+20				
30	6.35805E+12	19849335619	9.55E+19	3.94E+20				

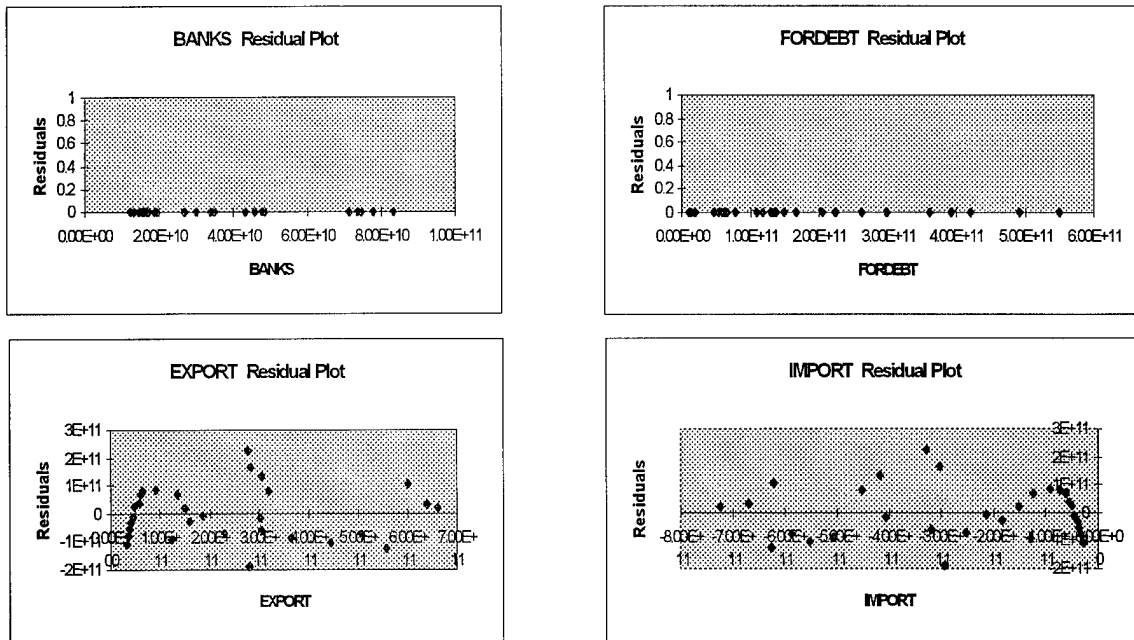


Figure A-20. Residual Plots for USA

Table A-35. Regression Analysis for USA (2)

SUMMARY OUTPUT							
<i>Regression Statistics</i>							
Multiple R	0.978116932						
R Square	0.956712734						
Adjusted R Square	0.949786771						
Standard Error	4.12364E+11						
Observations	30						
		99% Confidence					
ANOVA	n=30, k=5	Critical F (4,25)		4.18			
	df	SS	MS	F	Significance F		
Regression	4	9.39555E+25	2.35E+25	138.1343	1.167E-16		
Residual	25	4.2511E+24	1.7E+23				
Total	29	9.82066E+25					
	Coefficients	Standard Error	t Stat	P-value	Critical t ₉₉	Critical t ₉₅	Critical t ₉₉
Intercept	1.14564E+12	2.33851E+11	4.899022	4.84E-05	1.708	2.06	2.787
BANKS	2.947908634	15.45695625	0.190717	0.850287			
FORDEBT	2.402818042	0.976023457	2.461845	0.021067			
EXPORT	-6.44215E-12	2.86579E-12	-2.24795	0.033644			
IMPORT	1.41497E-11	2.96446E-12	4.773114	6.71E-05			
RESIDUAL OUTPUT							
Observation	Predicted GDP	Residuals	DW test	Correlation Table			
1	1.23016E+12	-5.8206E+11			BANKS	FORDEBT	EXPORT
2	1.22842E+12	-5.2572E+11	3.17E+21	2.76E+23	BANKS	1	
3	1.22516E+12	-4.55364E+11	4.95E+21	2.07E+23	FORDEBT	0.85573596	
4	1.23187E+12	-4.1757E+11	1.43E+21	1.74E+23	EXPORT	0.94762325	0.78113441
5	1.2395E+12	-3.50196E+11	4.54E+21	1.23E+23	IMPORT	0.96758126	0.80876802
6	1.24106E+12	-2.81556E+11	4.71E+21	7.93E+22			0.978217638
7	1.25903E+12	-2.4863E+11	1.08E+21	6.18E+22	Durbin Watson test for autocorrelation of residuals		
8	1.32517E+12	-2.28372E+11	4.1E+20	5.22E+22			
9	1.36503E+12	-1.58531E+11	4.88E+21	2.51E+22	DW statistic	0.32223324	
10	1.38287E+12	-33766878766	1.56E+22	1.14E+21	95% Confidence d _L	1.14	d _U 1.74
11	1.46423E+12	-6227296306	7.58E+20	3.88E+19			
12	1.44662E+12	1.38178E+11	2.09E+22	1.91E+22			
13	1.56923E+12	1.97872E+11	3.56E+21	3.92E+22			
14	1.77473E+12	1.99366E+11	2.23E+18	3.97E+22			
15	1.93483E+12	2.97871E+11	9.7E+21	8.87E+22			
16	2.05346E+12	4.35236E+11	1.89E+22	1.89E+23			
17	2.2562E+12	4.51897E+11	2.78E+20	2.04E+23			
18	2.39924E+12	6.3136E+11	3.22E+22	3.99E+23			
19	2.39127E+12	7.58328E+11	1.61E+22	5.75E+23			
20	2.6747E+12	7.30397E+11	7.8E+20	5.33E+23			
21	3.47633E+12	3.00873E+11	1.84E+23	9.05E+22			
22	3.68532E+12	3.53378E+11	2.76E+21	1.25E+23			
23	4.15217E+12	1.16429E+11	5.61E+22	1.36E+22			
24	4.78582E+12	-2.45925E+11	1.31E+23	6.05E+22			
25	5.20033E+12	-2.99926E+11	2.92E+21	9E+22			
26	5.53435E+12	-2.83551E+11	2.68E+20	8.04E+22			
27	5.94902E+12	-4.26819E+11	2.05E+22	1.82E+23			
28	5.6839E+12	39000877876	2.17E+23	1.52E+21			
29	6.38762E+12	-3.49116E+11	1.51E+23	1.22E+23			
30	6.13475E+12	2.43145E+11	3.51E+23	5.91E+22			

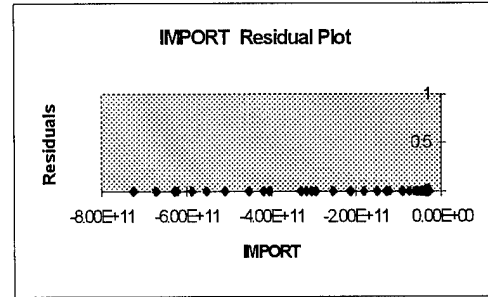
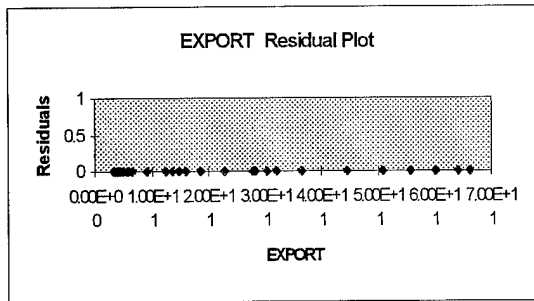
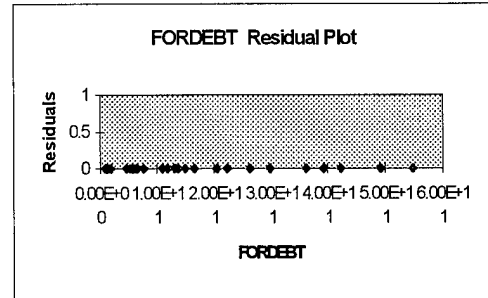
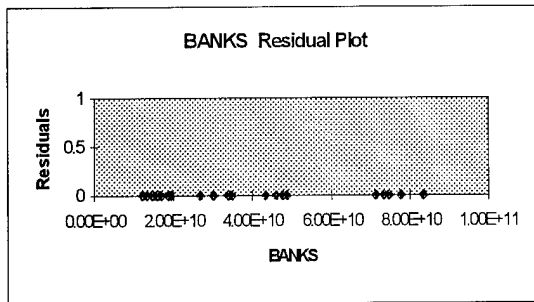


Figure A-21. Residual Plots for USA (2)

Table A-36. Regression Analysis for Zimbabwe

SUMMARY OUTPUT								
Regression Statistics								
Multiple R	0.999191425							
R Square	0.998383505							
Adjusted R Square	0.998089596							
Standard Error	601145808.6							
Observations	27							
		99% confidence						
ANOVA	n=27, k=5	Critical F (4,22):		4.41				
	df	SS	MS	F	Significance F			
Regression	4	4.91027E+21	1.23E+21	3396.922	2.3597E-30			
Residual	22	7.95028E+18	3.61E+17					
Total	26	4.91822E+21						
	Coefficients	Standard Error	t Stat	P-value	critical t ₉₀	crit t ₉₅	critical t ₉₉	
Intercept	728447272	226913424.1	3.210243	0.004034	1.717	2.074	2.819	
BANKS	3.630159549	1.694662056	2.142114	0.043507				
FORDEBT	3.654252043	0.041831879	87.35568	1.87E-29				
EXPORT	-1.39767E-10	4.85213E-11	-2.88054	0.008684				
IMPORT	1.93685E-10	6.14421E-11	3.152318	0.004622				
RESIDUAL OUTPUT								
Observation	Predicted GDP	Residuals	DW Test		BANKS	FORDEBT	EXPORT	IMPORT
1	730466599.5	-197609456.6			BANKS	1		
2	731873614.8	-130445043.4	4.51E+15	1.7E+16	FORDEBT	0.362511	1	
3	1044271153	-520699724.2	1.52E+17	2.71E+17	EXPORT	0.232186	0.593343	1
4	1051531472	-484388614.8	1.32E+15	2.35E+17	IMPORT	0.228538	0.584563	0.997232
5	844612377.6	-236040949	6.17E+16	5.57E+16				
6	932745677.9	-234888535.1	1.33E+12	5.52E+16				
7	937698153.5	-159928333.2	5.62E+15	2.56E+16	Durbin Watson test for autocorrelation of residuals			
8	867780614.7	51776365.78	4.48E+16	2.68E+15	DW Statistic	1.373151		
9	1004165958	7372231.079	1.97E+15	5.43E+13	95% Confidence d _L	1.08	d _U	1.76
10	1203495414	-79062017	7.47E+15	6.25E+15				
11	1021211848	209557383.2	8.33E+16	4.39E+16				
12	1022392014	436794644.6	5.16E+16	1.91E+17				
13	1244740175	313084911.5	1.53E+16	9.8E+16				
14	1266311715	460589604.9	2.18E+16	2.12E+17				
15	1927308369	147632258.5	9.79E+16	2.18E+16				
16	2793821494	-287382201.3	1.89E+17	8.26E+16				
17	2982344578	-214932643.4	5.25E+15	4.62E+16				
18	3460383873	239950017.2	2.07E+17	5.76E+16				
19	4813931243	457394449.2	4.73E+16	2.09E+17				
20	5812776184	1485834927	1.06E+18	2.21E+18				
21	9311443271	120073666	1.87E+18	1.44E+16				
22	13242221574	-87363091.66	4.3E+16	7.63E+15				
23	18156042551	-963924323.9	7.68E+17	9.29E+17				
24	23430930182	-1555487861	3.5E+17	2.42E+18				
25	27788902535	773188968.6	5.42E+18	5.98E+17				
26	39162471035	181204382.6	3.5E+17	3.28E+16				
27	56649030198	267698984.6	7.48E+15	7.17E+16				

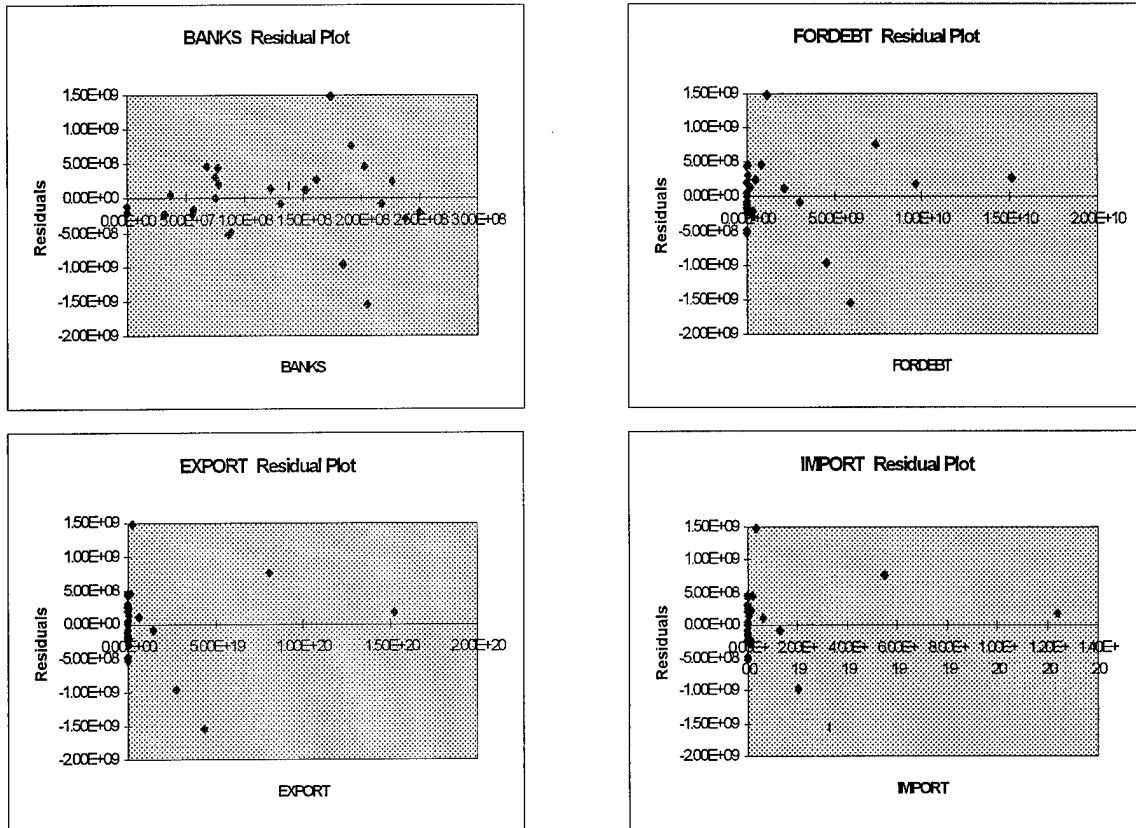


Figure A-22. Residual Plots for Zimbabwe

APPENDIX B

Table B- 1. Nodal Analysis of Trade System

<u>Leadership</u>	<u>System Essentials</u>	<u>Infrastructure</u>	<u>Population</u>	<u>Fielded Forces</u>
Individual Governments	Information	Communication/ Data Nets	Labor	Military
GATT	Raw Materials	Industry	Consumers	Department of Transportation
G-7	Energy	Transportation System		
IMF	Convertible Currency	Currency Exchange		
NGOs	Product	Commercial Banks		
	Treaties/ Agreements	Central Banks		
	Intellectual Capital	Government Policy		
		Bond Markets		
		Commodity Markets		

Table B- 2. Trade System Linkages

<u>Trade System Nodes</u>	<u># Nodes Dependent On</u>	<u># Nodes Important To</u>	<u>Total System Links</u>
<u>Leadership</u>			
Individual Governments	8	9	17
IMF	6	2	8
G-7	5	0	5
GATT	2	1	3
NGOs	2	0	2
<u>System Essentials</u>			
Raw Materials	4	4	8
Energy	3	5	8
Intellectual Capital	3	3	6
Convertible Currency	6	2	8
Treaties/Agreements	1	3	4
Information	1	13	14
Product	6	1	7
Industry	6	1	7
<u>Infrastructure</u>			
Communication/Data Nets	2	11	13
Currency Exchange	4	1	5
Bond Market	3	1	4
Central Bank	4	6	10
Commercial Banks	4	2	6
Commodity Markets	3	1	4
Transportation System	3	5	8
Government Policy	2	5	7
<u>Population</u>			
Labor	1	5	6
Consumers	4	2	6
<u>Fielded Forces</u>			
Military	1	2	3
Department of Transportation	1	0	1

Table B- 3. Application of Validity Check to Trade Critical Nodes

<u>Critical Nodes</u>	<u>Crit</u>	<u>Obj</u>	<u>Vul</u>	<u>Risk</u>	<u>Col Dam</u>	<u>Spd</u>	<u>Opn</u>	<u>Calc Depend</u>
Communication/ Data Networks	10	10	9	7	1	10	1	352
Information	10	9	0	0	5	7	0	349
Individual Governments	10	7	5	2	0	0	5	237
Central Banks	5	7	7	7	3	8	0	205

Legend:

Critical Nodes: Identified in Table 3 by linkages within the system

Crit: Criticality. Subjective measurement (1-10 scale) of criticality to system prior to linkage analysis

Obj: Relative measure (1-10 scale) of ability to use 4 instruments of power to achieve stated objective

Vul: Relative measure (1-10 scale) of node's exposure/vulnerability to outside attack

Risk: Relative measure (1-10 scale) of risk to us of attacking this node

Col Dam: Relative measure (1-10 scale) of anticipated collateral damage from attacking this node

Spd: Relative measure (1-10 scale) of how quickly our attack methods will be felt

Opn: Relative measure (1-10 scale) of effect on world opinion of attacking this node

Calc Depend: Coefficient of dependency. Weighted number taking into account the validity factors and number of linkages to determine a relative ranking among nodes

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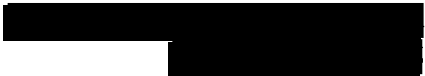
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VITAE

Major Mark Anthony, USAF. Major Anthony received his commission through the Reserve Officer Training Corps in 1981. He received his Bachelor of Science degree from Tuskegee Institute and is currently completing a Master in Business Administration from Troy State University. He has served tours at Barksdale AFB LA, KI Sawyer AFB MI, Ankara AS Turkey, and Peterson AFB CO, as the Chief of Accounting and Finance. His most recent assignment was with Air University at Maxwell AFB AL, as Chief of Financial Support Branch. He earned the best Air Force Accounting and Finance Office of the Year Awards in 1986 and 1987. Upon graduation, his follow-on assignment is to Yokota AB Japan where he will serve as the commander of the Japan Regional Accounting and Finance Operations.

PII Redacted



Major James Daniel, USAF. Major Daniel received his commission through the Reserve Officer Training Corps in 1981. He has a Bachelor of Science degree in accounting from Mississippi State University and a Master of Science in Operations Management from the University of Arkansas. After completing the Budget Officer school at Sheppard AFB in 1981, he enter the Comptroller career field where he has spent his entire career. His tours of duty include Wing Budget Officer at Charleston AFB, Little Rock AFB and Florence AB; Command Comptroller, Air Force Technical Application Center, Patrick AFB; and Chief/Comptroller, Air Force Intelligence Financial Management, Headquarters USAF.

Upon completing ACSC, he will serve as Commander, Defense Courier Service American Region.

PII Redacted

Lieutenant Commander Stuart Forsyth, USN. Lieutenant Commander Forsyth graduated from the United States Naval Academy in 1981. Upon completing nuclear power and submarine training, he spent three and a half years on board USS BIRMINGHAM (SSN 695) in a variety of division officer assignments. Following an assignment as a Company Officer at the US Naval Academy and the Submarine Officer Advanced Course, he served as Navigator and Operations Officer on board USS NORFOLK (SSN 714) from March 1989 to April 1991, as Submarine Liaison/ASW Officer on the staff of Commander Carrier Group FOUR from June 1991 to December 1992, and as Executive Officer on board USS JEFFERSON CITY (SSN 759) from April 1993 to June 1994. Upon graduation he will be reporting as Executive Officer on board USS CHICAGO (SSN 721) in August 1995. Lieutenant Commander Forsyth holds a Master of Science degree in Systems Management from the University of Southern California and a Master of Public Administration degree from Auburn University (Montgomery).

PII Redacted

Major Jeffrey B. Hukill, USAF. Major Hukill received his commission through the Reserve Officer Training Corps upon graduation from Norwich University, Vermont. After graduation from undergraduate navigator training and electronic warfare training his

first operational assignment was in the B-52 at Fairchild AFB WA. At Fairchild Major Hukill was an instructor and evaluator electronic warfare officer. In 1984 Major Hukill was transferred to Castle AFB CA where he served as a Combat Crew Training Instructor and the Wing Electronic Warfare Officer. At the completion of that assignment he was transferred to Ashland ME to become the Operations Officer and Squadron Commander of a Strategic Training Range. In 1991 he was selected to attend ACSC in residence and stayed on faculty at the completion of the school year. He has a Masters in Business Administration. Currently he is an operations officer at ACSC and teaches War Theory.

PII Redacted

Major Jonathan W. Klaaren, USAF. Major Klaaren received his commission through Officer Training School in 1981. After undergraduate navigator training his first assignment was in the F-4 at Seymour Johnson AFB NC. In 1986 he transitioned to the F-111 and was stationed at RAF Lakenheath UK. In the F-111 he participated in Operations DESERT SHIELD and DESERT STORM. In addition to flying, he has been a MAJCOM action officer responsible for F-111 formal training. He has a Master of Aeronautical Science degree and is a graduate of ACSC, Class of 1993. Currently he is an operations officer at ACSC and teaches war theory. His next assignment is to Seymour Johnson AFB NC in the F-15E.

PII Redacted

Major Kenneth M. Konicki, USAF. Major Kenneth M. Konicki is a 1980 graduate of the United States Air Force Academy. After an initial tour flying the KC-135 air refueling

tanker, Major Konicki returned to the Academy where he taught and course directed several financial courses for the Department of Management. Most recently, Major Konicki served as the Deputy Wing Inspector and Chief of Safety for the 380th Air Refueling Wing, Plattsburgh AFB NY. He holds a Master of Business Administration from the Harvard Business School. Upon graduation, Major Konicki will join the United States Transportation Command.

PII Redacted


Major Douglas W. Shaw, USAF. Major Shaw received his commission from Officer Training School in 1982. A B-52 Instructor Electronic Warfare Officer, he has served in a variety of positions in four Bomb Wings. He also instructed at Officer Training School and was recognized as the Instructor of the Year for both OTS and the Lackland Training Center. Prior to joining the Air Force, Major Shaw worked for the IBM Corporation as a marketing representative. In this position he advised government and education accounts and garnered numerous sales awards. He has a BBA from the University of Texas at El Paso and a Master of Business Administration from City University in Bellevue WA.

PII Redacted

Major David E. Timmons, Canadian AF. Major Timmons received his commission in the Canadian Armed Forces upon completion of Undergraduate Pilot Training in 1981. He served his first tour with 408 Tactical Helicopter Squadron in Edmonton as flying the Twin Huey helicopter. From 1984 to 1987 he served as an instructor at 3 Canadian

Forces Flying Training School and held the positions as Deputy Chief Helicopter Instructor and Chief of Rotary Wing Standards. Upon completion of an undergraduate degree program in Economics and Management he served as an analyst in Manpower Planning (J1) at National Defense Headquarters. Prior to being selected for ACSC, Maj Timmons served as operations officer and flight commander from 1992 to 1994 with 408 Squadron.

PII Redacted

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